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Water

Economic Benefits of the Clean Lakes Program

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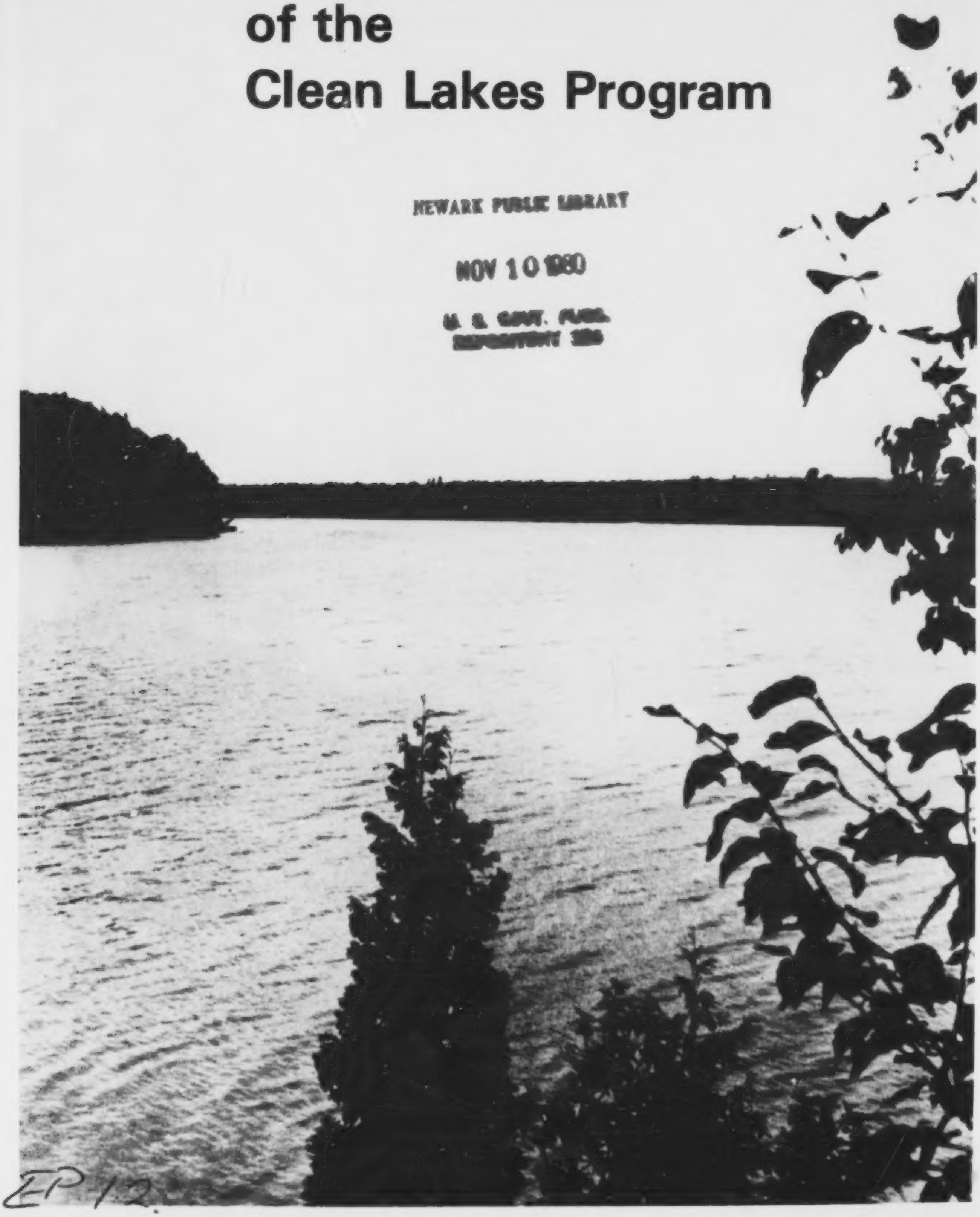

EP 1.2.

AN ASSESSMENT OF ECONOMIC BENEFITS OF 28 PROJECTS IN THE SECTION 314 CLEAN LAKES PROGRAM

Prepared in March 1980 for

The United States Environmental Protection Agency
Office of Water Regulations and Standards
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September 1980

REVIEW NOTICE

This report has been reviewed by the Office of Water Regulations and Standards, EPA, and approved for publication. Approval does not signify that the contents necessarily reflect the views and policies of the Environmental Protection Agency, nor does mention of trade names or commercial products constitute endorsement or recommendations for use.

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The cover photograph was taken during the site visit to Little Pond in Lincoln County, Maine, December 18, 1979.

EXECUTIVE SUMMARY

By the end of fiscal year 1979, the Clean Lakes Program had approved 105 grants totalling $40,097,110 -- 23 for state classification surveys and 82 for study and restoration work at specific lakes. Benefits were assessed for a 28-project sample drawn from the second group.

The 28 projects, involving $15,349,053 in Federal funds and an approximately equal sum from state and local agencies, are producing benefits in twelve categories: recreation, aesthetics, flood control, economic development, fish and wildlife, agriculture, property value, public health, multiple use (commercial fishing and public water supply), education and research and development, pollutant reduction, and miscellaneous items such as resource recovery and reduced management cost. Many benefits could not be measured in monetary terms, but the present value of those which could is $127,488,500. This represents a return of $8.30 per Federal dollar expended, or $4.15 per total project dollar.

Investigators reached two other conclusions besides the obvious finding that the program has a high benefit yield. First, the successes of many Clean Lakes projects appear to have been catalysts for other community activities, some closely related to environmental protection and some not. Second, at a time when government spending is under continued public scrutiny and many programs are looked on with at least some disfavor, this one seems to be almost universally popular among those who have participated in it.

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INTRODUCTION

The Clean Lakes Program became a reality on January 6, 1976 with the award of the first grant. From that date through September 30, 1979, the Environmental Protection Agency has awarded 105 grants, totalling $40,097,110, for projects in 37 states. They include 23 classification grants, awarded to states to survey and determine the condition of their publicly-owned lakes, and 82 grants to state or local agencies to study and restore specific lakes with serious water quality problems.

Publicly owned lakes are the only lakes which are eligible for a grant under Section 314. There are, by conservative estimate, more than 36,800 of them, with a combined surface area of nearly 11 million acres.[1] How many are presently or potentially eutrophic or otherwise so degraded in quality as to require the corrective or preventive measures typical of a Clean Lakes project is impossible to estimate, but if the experiences of Wisconsin and Illinois are mirrored throughout the United States, the number could exceed 10,000.[2,3]

A lake's quality is closely related to activities in its watershed and materials transported by its tributaries, which is why Clean Lakes projects so often include major watershed management and tributary quality improvement components. The aggregate drainage area of the nation's lakes is at least 1.5 million square miles - 42 percent of its total surface area - and those watersheds are drained by approximately 1,400,000 miles of rivers and streams.

Hydrographic statistics tell only part of the story. Another way of measuring the importance of lakes in the United States is to describe their uses. For example, commercial fishing is significant in lakes in a number of states.[4] As another example, the Water Resources Council estimates that between 30 and 40 percent of the nation's public water supply is withdrawn from lakes.[1] Recreation in many forms is of course the most obvious use of publicly owned lakes.

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[1] See Appendix A for details and sources of this and other statistics in the Introduction.

[2] Illinois Environmental Protection Agency, "Assessment and Classification of Illinois Lakes", Vol. I, December, 1978, p. 52.

[3] Wisconsin Department of Natural Resources, "Classification of Wisconsin Lakes by Trophic Condition", April, 1975, p. 4.

[4] National Oceanic and Atmospheric Administration, National Marine Fisheries Service unpublished data on commercial fish catches by state.

It is a striking fact, in a time of energy shortages and rising fuel costs, that 211,517,000 people, or 99.4 percent of the 1975 population of the United States, live within 50 miles (one hour's drive) of a publicly owned lake. Fully one-third of them live five miles or less from a lake -- a long walk, a comfortable bicycle ride, or a short bus trip. Many of these 70,135,000 people are city-dwellers, for over 2,500 of the country's lakes may be described as urban. As shown in Figure 1, seven-eighths of the country's land area lies within the 50-mile radius of at least one lake.[2]

People who live near the seacoast have a ready alternative to lake recreation and may prefer to travel to the ocean in their leisure time. It is thus significant that only 6,000 publicly owned lakes are within 50 miles of the coastline. The other lakes, nearly 31,000, are located further inland, valuable recreation resources for the large number of people for whom a trip to the seashore is either practically or economically impossible.

This report is an assessment of the benefits of the Clean Lakes Program, the purpose of which is to restore and preserve publicly owned lakes, a valuable national resource which has been described in several different ways in the preceding paragraphs. The next section is a description of the methodologies applied in the assessment. It is followed by a presentation and discussion of findings and a set of recommendations for continuing assessment of program benefits. At the end of the report are a series of appendices containing additional details and supporting data.

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[1] Water Resources Council, unpublished estimates.

[2] More detailed lake location information would probably result in reduction of the shaded area.

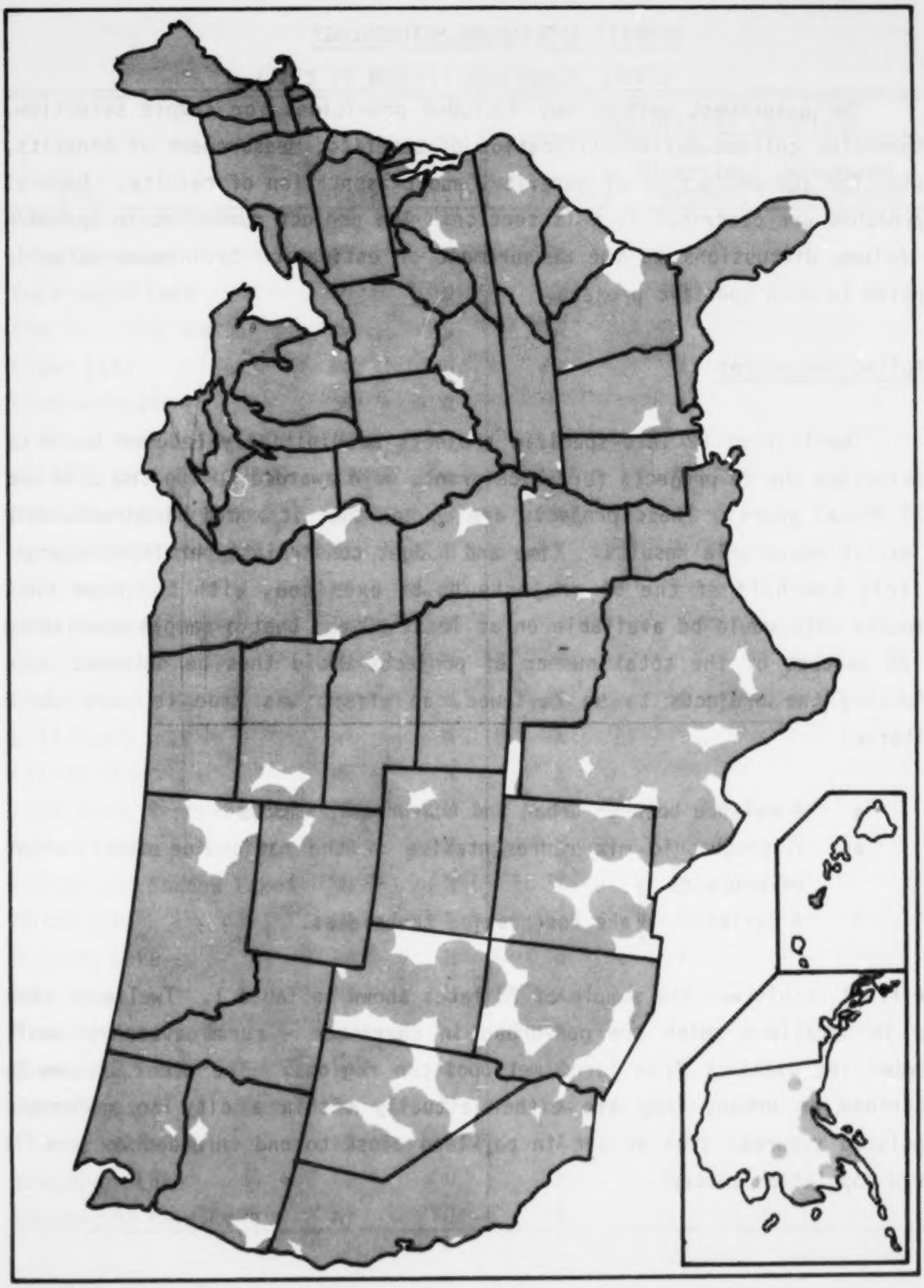

Figure 1: LAND AREA WITHIN 50 MILES OF A PUBLICLY OWNED LAKE

BENEFIT ASSESSMENT METHODOLOGY

The assessment methodology included provisions for sample selection, information collection, identification of benefits, measurement of benefits, estimation and projection of benefits, and presentation of results. General approaches are described in this section. The project summaries in Appendix B include discussions on the measurement or estimation techniques actually applied to each specific project.

Sampling Procedures

The list of 82 lake-specific projects was initially reduced to 54 by eliminating the 28 projects for which grants were awarded during the 1978 and 1979 fiscal years. These projects are so new that it would be unreasonable to expect measurable results. Time and budget constraints permitted approximately one-half of the 54 projects to be examined, with the hope that adequate data would be available on at least 20 and that a sample consisting of 25 percent of the total number of projects would thus be obtained. In selecting the projects to be reviewed, an effort was made to meet three criteria:

- A balance between urban and non-urban projects
- A geographic mix representative of the nationwide distribution of projects
- A variety of lake restoration techniques.

The final result was the sample of 28 lakes shown in Table 1. Twelve of them are in locations which are non-urban in character - rural areas or small communities distinct from large metropolitan regions. The other 16 can be described as urban; they are either actually within a city or a densely populated suburban area or are in parkland close to and intended to serve a large population center.

Table 1

LAKES IN BENEFIT ASSESSMENT SAMPLE

Lake	State	Setting[a]	Restoration Technique In-Lake	Dilution/ Diversion/ Treatment	Watershed Management
Annabessacook Lake	ME	N	X		X
Lake Bomoseen	VT	N	X		
Buckingham Lake	NY	U	X		
Charles River Basin	MA	U	X		
Clear Lake	MN	N		X	
Lake Cochrane	SD	N		X	
Collins Park Lake	NY	U	X	X	
Ellis Lake	CA	U	X	X	X
59th St. Pond	NY	U	X		
Frank Holten Lakes	IL	U	X	X	
Lake Henry	WI	N	X		X
Lake Jackson	FL	U		X	
Lake Lansing	MI	U	X		
Liberty Lake	WA	N	X	X	X
Lilly Lake	WI	N	X		
Little Pond	ME	N	X		
Loch Raven Reservoir	MD	U	X		
Medical Lake	WA	N	X		
Mirror and Shadow Lakes	WI	N	X	X	
Moses Lake	WA	N		X	
Nutting Lake	MA	N	X	X	X
Penn Lake	MN	U	X	X	
Rivanna Reservoir	VA	U	X		X
Steinmetz Pond	NY	U	X	X	
Lake Temescal	CA	U	X	X	X
Tivoli Lake	NY	U	X	X	
Vancouver Lake	OR	U	X	X	X
Washington Park Lake	NY	U	X		

a. U = urban, N = non-urban

Information Collection

Field investigators obtained contacts for the projects from the Clean Lakes Coordinator in each EPA regional office and arranged site visits. Each site visit consumed from one to three days and included interviews with the grantee and other sources such as cognizant state agencies, local and regional planning organizations, health departments, realtors, chambers of commerce, civic and conservation group members, and project consultants. At the conclusion of each visit results were compiled on a standardized form and submitted for analysis.

Identification of Benefits

Clean Lakes project benefits were anticipated in one or more of eleven areas:

- Recreation
- Aesthetics
- Flood Control
- Economic Development
- Fish and Wildlife
- Agriculture
- Property Value
- Public Health
- Water Supply
- Education, R&D
- Miscellaneous

A checklist was prepared listing screening questions, key variables, and likely information sources for each benefit to insure that every investigator thoroughly covered all possible categories in a reasonably consistent manner.

Measurement of Benefits

The primary objective of the study was to express benefits in monetary terms. However, that is an objective which cannot be met for all categories. Benefits which manifest themselves as increases in property values or decreases in management costs can readily be stated in dollars. There are other benefits, such as increased community awareness of environmental problems, which can only be described qualitatively. Both types were considered in this assessment.

Benefits of Clean Lakes projects can accrue in any or all of four ways. First, lake restoration may increase the extent of one or more existing uses. Second, it may result in new uses, or the reestablishment of uses lost through deterioration of water quality. In both cases, benefits are calculated, where calculation is possible, by multiplying the increase in usage by an estimate of unit value for the use. This is known to economists as the "value of activity increase approach".

The third case is that of improvement in quality of an existing use. This is reflected in an increase in unit value, and the benefit can be calculated by multiplying the existing usage by the change in value -- another application of the value of activity increase method.

Finally, a common consequence of a Clean Lakes project is that the present extent and quality of a lake use are protected or preserved. Measurement of benefit in this case is accomplished by determining the existing level of benefit and estimating the annual rate of decline in usage or value which would occur in the absence of the project. This increment of loss prevented is the project benefit, and it is cumulative. In other words, if boating is expected to become impossible in 10 years because of rapid siltation, the benefit of effective erosion control in the first year is 10 percent of the present boating benefit. In the second year that 10 percent is still protected and the loss of an additional 10 percent is prevented for a total of 20 percent.[1] In practice, it is difficult to predict the annual rate of decline, even in the rare instance where there are lengthy historical records. For this assessment, the highest rate was 10 percent, applied to small lakes with the kinds of water quality problems which could potentially eliminate certain benefits in ten years. For larger lakes, or less severe problems, 1 or 2 percent was the rate applied. Selection of the rate was admittedly a matter of judgement on the part of the investigator as well as the individuals interviewed at the site.

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[1] In calculating benefits of this type, the loss of benefit that would have occurred without the project is assumed to increase from zero to the annual increment selected at a uniform rate over the year. At a 10 percent increment, the actual benefit in the first year would be 5 percent, the mean of the January 1 and December 31 values of zero and 10 percent, respectively. The second year benefit would be 15 percent and the tenth year's, 95 percent. The complete loss of benefit would not have been experienced until the end of the tenth year.

It is important to note that there are other categories in which benefit is measured by dis-benefits which do not occur. A common example is reduction in lake management expenditures by the municipality as a result of pollutant loading reduction. Measurement of benefits in this way is known as the "cost savings approach".

A different approach to benefit measurement which cuts across all four of the cases just described is the "capitalization approach". It assumes that the value of all or most benefits associated with environmental quality improvement are reflected in property value increases near the site. A number of investigators have shown that the market value of property is in fact affected by the existence and extent of and proximity to environmental amenities or nuisances.[1] Consequently, property value changes can be used as a measure of other benefits, some of which may not be directly measurable themselves. It is usually difficult to obtain sufficient data to apply this technique to a relatively new project, but we were able to use it in several cases. Where it is used in conjunction with any other method, great care must be exercised to avoid double counting of benefits. For example, it would not be correct to include property owners in the total number of recreators if both property value and recreation user-day increases were included in benefits.

Estimation of Usage and Unit Value

In an ideal situation, benefits can be measured directly from known changes between pre-project and post-project usage levels and unit values determined by actual cost or by site-specific surveys of "willingness-to-pay" for a given benefit. In most cases, however, one or more of the necessary ingredients is missing and must be estimated.

When complete usage measurements are not available, usage can often be estimated on the basis of partial records. For example, a rule-of-thumb stated by the Water Resources Council is that total annual user-days for outdoor recreation facilities in areas with seasonal variation can be approximated by 50 times the design load, where design load is the number of visitors on an average summer Sunday.[1] Usage can also be assumed to be equal to capacity, provided that excess recreational demand can legitimately be assumed to exist in the region.[2] Usage at similar facilities nearby can be used to develop estimates, or pre-project levels at the site in question can be assumed to be restored by the project. Finally, usage can be estimated on the basis of regional population by using per capita statistics such as "Recreation Participation: Number of Summer Occasions Per Capita Over 12 Years Old", developed by Bureau of Outdoor Recreation (Heritage Conservation and Recreation Service).[3]

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[1] For example: David, E. L. and W. B. Lord, "Determination of Property Value on Artificial Lakes", Department of Agriculture Economic Bulletin 54, University of Wisconsin, 1969; Knetsch, J. L., The Influence of Reservoir Projects on Land Values, Journal of Farm Economics, 46:231-243, 1964; and Schutjer, W. A. and M. C. Hallberg, Impact of Water Recreational Development on Rural Land Values, American Journal of Agricultural Economics, 50(3):572-583, 1968.

The unit value to be applied to a given use or resource -- the willingness-to-pay -- can sometimes be estimated by determining the cost of the "most likely alternative". For example, when confronted with a taste-and-odor problem in public drinking water, the amount of money an individual spends to obtain alternative supplies is a measure of the value of the public supply.

The most common unit value estimating problems are in the areas of recreation and aesthetics. The method adopted for this study is the "Unit Day Value" (UDV) method recommended by the Water Resources Council for use when regional models or site-specific surveys are not feasible.[4] The UDV method provides a means for estimating willingness-to-pay for recreation on the basis of certain charactersitics of the water resource under study:

- Recreation Experience - number of activities available
- Availability of Opportunity - proximity to alternative sites
- Carrying Capacity - adequacy of facilities
- Accessibility - proximity and quality of access routes
- Environmental Quality - primarily aesthetic factors.

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[1] 18 CFR 713, Procedures for Evaluation of National Economic Development (NED) Benefits and Costs in Water Resources Planning (Level C), Appendix 3 to Subpart K (Reproduced as Appendix C to this report).

[2] 18 CFR 713.917.

[3] Contained in U.S.D.A. Soil Conservation Service, "Recreation Ready Reference", August 1977, Chapter 2.

[4] 18 CFR, Appendix 3 to Subpart K.

A lake can be rated in each category on a point scale developed by WRC, and the sum of the points assigned can be converted, using another scale, to a dollar value for a unit day of recreation. By using only the "Environmental Quality" category, a value can be assigned to aesthetic amenity as well. Because we have relied heavily on the UDV tables to determine absolute and incremental recreational values where the grantee did not provide them, they are reproduced as Appendix C of this report.

Unfinished or uninitiated projects where the grantee has not made projections of benefits are simply special cases of estimation. Any of the various estimating techniques described above can be used to project benefits. Whenever this was done, conservative assumptions were made to minimize the risk of overstating benefits. For example, unless there was good reason to project an increase, future usage was projected to be a continuation of present levels. Projections are clearly noted in the individual lake summaries which appear in Appendix B.

Presentation of Results

To permit comparison to 314 grant amounts, all future benefits to which dollar values could be assigned were discounted to present value. The discount rate used, 7-1/8 percent, is that currently in effect for water and related resources planning, as approved by the Water Resources Council. The period used in discounting most streams of recurring benefits was 10 years. This is a much shorter period than that typically used in water resource planning; it reflects the greater uncertainty associated with predicting the length of time good water quality will be maintained as opposed to determining the useful life of a facility such as a flood control dam.

Findings are summarized in the next section of this report. Appendix B contains individual summaries for each project assessed.

RESULTS AND CONCLUSIONS

The results of the benefits assessment are summarized in Table 3 and are detailed by project in Appendix B. The table lists for each project in the sample the categories of benefit documented and the forms in which they are expressed. For benefits which could be expressed in monetary terms, total discounted benefits and 314 grant amounts are compared. This comparison shows that the stream of benefits resulting or projected to result from the expenditure of $15,349,053 in 314 grant moneys has a present value of $127,488,500. In other words, each Federal dollar expended has triggered $8.30, plus significant non-monetary items, in benefits. Taking the local share of all project funding as exactly equal to the Federal share (in a few cases it was slightly higher), the total expenditure of $30,700,000 is returning quantifiable benefits at the rate of $4.15 per project dollar.

It is instructive to break down this result into urban and non-urban categories. For the sixteen urban-area projects (see Table 1, page 5):

Total Discounted Benefits	Total 314 Grants
$90,777,300	$9,414,622

The totals for non-urban projects are:

Total Discounted Benefits	Total 314 Grants
$36,711,200	$5,934,431

Each Federal dollar expended on an urban project thus has associated with it monetary benefits valued at $9.64. The corresponding value for the non-urban projects is $6.19. Both amounts may be halved to relate monetary benefits to total project dollars. The "return on investment" in an urban lake tends to be higher, primarily for the logical reason that some benefits, especially recreational, add up more quickly in areas with larger populations and thus more users.

In only three projects in the sample of 28 does it appear that the Federal share of project funding will exceed the dollar value of benefits to be realized. Five additional projects show costs in excess of monetary

Table 3

SUMMARY OF BENEFITS FROM 28 CLEAN LAKES PROJECTS

Lake	Recreation	Aesthetics	Flood Control	Economic Dev.	Fish/Wildlife	Agriculture	Property Value	Public Health	Water Supply	Education R&D	Miscellaneous	Total Discounted Benefits[a] ($)	314 Grant Amount ($)
Annabessacook	+	+		$		+	$			+		23,246,100	497,906
Bomoseen	$	+								+	+	1,830,500	74,640
Buckingham	$			+						+		127,700	23,250
Charles	$	$								+		2,286,600	387,163
Clear	$	$		+	+			+		+		471,500	358,682
Cochrane	$	+			$		+			+		52,500	9,906
Collins Park	$	+								+		51,700	79,355
Ellis	$	$	$	$	+	$		+		+	$	11,123,000	1,625,000
59th St. Pond	$	+	+					+				4,837,000	498,035
Frank Holten	$	$		+				+		+	+	1,862,300	927,000
Henry	$					+	+			+	$	134,200	220,000
Jackson	$	$			+		+					7,309,800	725,663
Lansing	$			+			+			+		1,155,900	800,000
Liberty	$	$					+	+		+		813,000	577,975
Lilly	+	+			+		$			+		2,880,000	350,000
Little Pond		+							$	+		212,200	9,946
Loch Raven	$	$							$	+		11,944,100	150,900
Medical	$	+			+		$					931,700	128,217
Mirror and Shadow	$						+	+		+		312,700	215,000
Moses	$	+								+	+	534,700	3,251,000
Nutting	$	$		$			+	+		+		5,292,100	241,159
Penn	$	$		+	+					+	$	186,000	87,900
Rivanna	$								$	+		923,500	63,835
Steinmetz	$	+	+	+				$		+		126,300	36,680
Temescal	$	$						$		+	$	1,112,500	315,618
Tivoli	$	+	+	+				+		+		240,100	202,645
Vancouver	$	+		+		$		+		+		47,370,000	3,468,328
Washington Park	$	$								+		120,800	23,250
Totals												127,488,500	15,349,053

Benefits code: "$" in monetary terms; "+" in qualitative terms.
Note a: Total discounted benefits include "$" items only.

benefits if the entries in the "314 Grant Amount" column are doubled to reflect the state and local share. Two of the three lakes in which the Federal grant exceeds the present value of benefits are non-urban, as are three of the five additional lakes added to the costs-exceeding-benefits list when total project cost is considered.

Recreation and aesthetics account for the largest share of the total discounted benefits. There are a number of reasons for this, the first and most obvious being that they were the categories in which grantees most often had compiled some form of numerical data. Second, the field of water resources planning has a long history of attempts to quantify recreational and aesthetic benefits, during which a number of useful estimating tools such as the UDV method have been developed for that purpose. This assessment, as a consequence, unavoidably emphasized those categories. It is an emphasis which is probably appropriate, however, for it is the perceptions and reactions of shoreline residents and recreational users, who are not trained in limnology, which most frequently focus attention on lake water quality problems in the first place and thus trigger the grant application process. Most lake restorations programs have aesthetic improvement and maintenance or enhancement of recreational opportunity as primary objectives. Therefore, insofar as success is measured by progress toward objectives, it will inevitably be measured in terms of recreational and aesthetic benefit. Among the lakes in this sample, only Little Pond, restricted to use as public water supply, did not receive heavy emphasis on recreation.

Recreational benefits include a mixture of preservation or protection, improvement of quality, and increase in opportunity. At one extreme, for example, is Lake Bomoseen, in which gradual loss of recreational potential was the chief concern. It was analyzed as a case of preservation of existing recreational levels. Ellis Lake, on the other hand, had lost nearly all recreational value, and the project was seen as restoring benefits. Medical Lake was experiencing not only great improvement in quality of existing but limited recreational and aesthetic benefits but also was adding a new opportunity, trout fishing.

Perception of water quality and presence or absence of nuisance conditions - in other words, aesthetic amenity - are factors taken into account in estimating recreational benefits. In this assessment, aesthetic and recreational benefits are combined except in cases where there are clearly two types of users - one group whose use involves recreation in, on, or close to the lake, and another group for which the lake is only a visual amenity or a part of the general setting for activities which are unrelated to the water. Then, separate recreational and aesthetic benefits are estimated, since UDVs and usage levels are usually quite different.

For only four projects could flood control benefits be documented, and flood control or improved storm drainage appeared to be more than an incidental benefit in only two of those, Ellis Lake and 59th Street Pond.

Economic development was one of the most difficult categories to deal with. In eleven projects, some benefits to the local or regional economy were anticipated, principally in the form of new residential construction, reclamation of undevelopable land, and a few jobs for Youth Conservation Corps members or park employees. Numerical data were rarely available for assessment of primary benefits, and never for secondary effects such as the demand for goods and services that would be generated by new property owners, or as a result of increased tourism.

In a sense, fish and wildlife would benefit in the long run from most of the restoration projects, although they might be adversely affected during the actual work on the lake. Fish and wildlife benefits were recorded in this assessment when they were either named as objectives and those objectives were attained, or when a documented condition affecting fish and wildlife, such as winter kill, algal toxicity, or siltation of spawning area, was abated by the project.

Most projects did not appear to have agricultural benefits. Implementation of best management practics was documented as a benefit in only two cases, Lake Henry and Annabessacook Lake. Nearly one-third of the benefits projected for Vancouver Lake are in the form of land reclamation for potential cultivation, and in the case of Ellis Lake, a primary objective of the project was erradication of a weed with the potential to drastically curtail California's rice production.

Changes in property value, as described in the Methodology section, can be used as an overall measure of perceived and actual lake quality, although more research on the quality-to-value relationships needs to be accomplished. Only in the case of Annabessacook Lake and Lake Lilly was there enough local information to permit realistic computations of property value increases. In the case of projects which had preservation of lake quality as their primary objectives -- Lake Bomoseen and Lake Jackson, especially -- it was possible to estimate benefits in terms of property value preserved. For most projects, it is premature to try to measure property value changes; there has not been time for a sufficient number of turnovers and reassessments to occur.

The most common public health benefits were reductions of fecal coliform counts and turbidity, the latter a factor in swimming safety. The benefit was usually measured implicitly as part of improvements in recreational value or water supply. The one site where beach closing records were available, Lake Temescal, is the only one in which a quantitative benefit could be assigned explicity to public health.

In the case of public water supply, benefits could be estimated rather precisely in terms of savings in treatment costs.

Education, research and development, a documented benefit in almost every project, took four different forms. First, the lake or the project could be serving as an educational opportunity for students. Second, the improved lake could be the main attraction of a nature study program or facility. Third, the project could include an explicit educational component, to instruct citizens in some form of best management practice, for example. Finally, the project could purposely or coincidentally be serving as a demonstration or pilot study for researchers and practitioners of lake management and restoration. For instance, the State of Maine has already implemented the techniques applied at Little Pond in another lake, with no need for further Federal funding assistance.

Pleasingly evident in most of the projects was heightened awareness of the value of lakes and other features of the natural environment, and strengthened commitment to environmental protection. This was included as an educational benefit wherever it was observed.

In the "miscellaneous" category were placed such benefits as commercial fishing, reduced lake management costs, reduction in the need for pesticide use, and non-specific but beneficial use of dredge spoil.

In no particular category but apparent at nearly every lake, was a phenomenon we have chosen to describe as an improvement in community spirit. Citizens we spoke with were proud of their projects. Perhaps the most unmeasurable of the qualitative benefits, it is nevertheless a very important one. In some cases, it has manifested itself tangibly in increases in related community activities -- enlarged membership in the local lake association, for example, or voluntary implementation of best management practices. One town has applied for and received state aid for lakeside park improvements and is now applying for HUD funding to aggressively attack urban problems; its successful lake project seems to have been the catalyst. At other locations, the manifestations were less specific but no less apparent -- people simply felt good about the restored lakes.

Part of the reason for this community response to the Clean Lakes program can be found in looking at those two or three projects where we did not encounter it. There, the negative feelings were in response to delays, largely because of administrative problems, which had postponed any noticeable beneficial result.

The very substantial benefits shown in Table 1 are thus only part of this assessment; the rest is the observation that the program appears to be almost universally popular with those that have involved themselves in it, because it produces tangible results in a reasonable amount of time. Having had to provide or promote 50 percent of the funding, the participating communities are committed to their restoration projects, and they have been rewarded with quick action and visible improvements. Their enthusiasm, while intangible and unquantified, is nonetheless both real and communicable; after the site visits, we felt good about the projects too.

RECOMMENDATIONS

In order to maximize the benefits realized from Section 314 funding, to provide the soundest possible basis for selection of projects for grant awards from among the many lakes which may be eligible, and to permit evaluation of project results in the most appropriate terms, benefit assessment should become a permanent, ongoing part of the Clean Lakes Program, integrated into it at the project level and monitored by the EPA Headquarters staff.

This general recommendation is made on the basis of four characteristics of most Clean Lakes projects. First, they are highly benefit oriented. In other words, they are often defined, and always perceived, in terms of desired or expected changes in lake use. Second, actual or projected benefits are difficult to measure or estimate because of the lack of good baseline data on existing lake uses and on availability of and demand for existing and anticipated uses. Third, insofar as benefit assessment has been possible, it shows that benefits vary widely from project to project, not only because of differences in lake characteristics and restoration techniques, but also with variations in climate, geographic location, regional population density, lake surroundings, available facilities, and proximity to other bodies of water. Finally, public acceptance of lakes projects, and the local share of their funding, is dependent on perceptions of potential or actual benefit.

The recommendation can be implemented most effectively in the following manner.

1. State classification surveys should include information relevant to determining potential project benefits, such as description of geographic and demographic setting, current uses and facilities, and, when available, data on present usage levels.
2. Applicants for Section 314 funding should be required to state the objectives of proposed projects in terms of changes or improvements in lake use.
3. The benefits to result from those changes should be estimated in order to provide justification for proposed projects. This

justification should include an approximation of present usage of the lake and projections of future usage after restoration.

4. In making the projections, proper consideration should be given to:
   (a) Potential demand for projected uses;
   (b) Capacity and capability to "deliver" those uses, once available; and
   (c) Existence, proximity, and relative attractiveness of alternative supplies of those uses.
5. Comments on the projections from cognizant agencies, such as local and regional plannning organizations or park and recreation departments, should be included with the application.
6. When a project is funded, the initially stated objectives in terms of uses and benefits should be refined and procedures for monitoring and measuring progress toward them should be established.
7. Procedures for developing useful, quantitative baseline data on benefits should be a part of the work plan, to provide the starting point for monitoring.
8. Upon completion of restoration or preventive activities, a mechanism for monitoring and reporting benefits should remain in place.
9. EPA Headquarters staff should receive and review reports of benefits achieved and should produce an annual assessment of program benefits from them.

It should still be possible to obtain baseline information, define objectives in terms of benefits, and monitor achievement in ongoing projects. This could be accomplished by the grantee, with technical assistance from EPA as necessary.

For completed projects which have not been reviewed in this study, the feasibility of obtaining baseline benefits data and monitoring benefits should be investigated. Projects which were included in the study should be monitored to determine the extent to which estimates and projections of benefits are realized.

Appendix A

LAKE INVENTORY DATA

Table A-1	Inventory of Publicly Owned Lakes
Table A-2	Estimate of Population Residing Within Fifty and Five Miles of at Least One Publicly Owned Lake
Table A-3	Distribution of Urban, Rural, and Coastal Public Lakes

[illegible]

[illegible]

(a) [illegible]

(b) [illegible]

(c) [illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

Table A-1. INVENTORY OF PUBLICLY OWNED LAKES

State	State Total[a]	Drainage Area $(mi^2 \times 10^3)$[a]	Surface Area $(ac \times 10^3)$[b]	Tributary Length $(mi \times 10^3)$[c]
EPA Region I				
Connecticut	142	5.4	NA	5.0
Maine	3,000	15.8	NA	14.5
Massachusetts	1,302	0.8	106.0	0.7
New Hampshire	978	7.6	169.6	7.0
Rhode Island	5	0.1	NA	0.1
Vermont	19	12.1	40.4[d]	11.1
EPA Region II				
New Jersey	375	0.7	31.5	0.6
New York	2,822	21.6	NA	19.9
EPA Region III				
Delaware	30	0.2	2.4	0.2
Maryland and DC	12	27.6	NA	25.4
Pennsylvania	193	8.6	56.4	7.9
Virginia	19	12.2	NA	11.2
West Virginia	34	1.3	NA	1.2
EPA Region IV				
Alabama	83	45.8	2.0	42.1
Florida	1,054	54.2	1,876.4	49.8
Georgia	74	29.9	NA	27.5
Kentucky	817	4.8	65.8	4.4
Mississippi	107	4.6	143.9	4.2
North Carolina	97	42.1	NA	38.7
South Carolina	171	18.0	534.3	16.5
Tennessee	177	38.8	653.4[e]	35.7
EPA Region V				
Illinois	271	9.2	156.1	8.5
Indiana	276	11.3	NA	10.4
Michigan	3,326	13.7	528.5	12.6
Minnesota	2,065	4.8	NA	4.4
Ohio	207	16.9	118.2	15.5
Wisconsin	871[f]	9.9	701.3	9.1
EPA Region VI				
Arkansas	344	53.0	329.3	48.7
Louisiana	157	12.5	610.2	11.5
New Mexico	160	73.5	58.4	67.5
Oklahoma	1,894	68.2	701.2	62.7
Texas	240	224.3	NA	206.1

Table A-1. INVENTORY OF PUBLICLY OWNED LAKES (CONTINUED)

State	State Total[a]	Drainage Area (mi^2 x 10^3)[a]	Surface Area (ac x 10^3)[b]	Tributary Length (mi x 10^3)[c]
EPA Region VII				
Iowa	88	0.6	NA	0.6
Kansas	91	66.9	48.3	61.5
Missouri	102	57.4	NA	52.7
Nebraska	224	1.5	113.9	1.4
EPA Region VIII				
Colorado	271	57.4	NA	52.7
Montana	86	215.8	NA	198.3
North Dakota	211	32.5	NA	29.9
South Dakota	742	9.5	648.6	8.7
Utah	1,863	27.3	394.2	25.1
Wyoming	57	2.3	NA	2.1
EPA Region IX				
Arizona	157	0.6	352.6	0.6
California	4,034	117.0	1,050.1	107.5
Hawaii	2	NA	NA	NA
Nevada	67	2.9	379.2	2.7
EPA Region X				
Alaska	83	NA	534.3	NA
Idaho	96	30.7	NA	28.2
Oregon	6,619[g]	0.9	587.9	0.8
Washington	717	57.0	NA	52.4
TOTAL	36,832	1,529.8	10,994.4	1,405.8

[a] Estimates based on state-collected data and/or nationally catalogued data as obtained from the National Water Data Exchange, U.S.G.S.

[b] Estimates based only on state-collected data which frequently excludes smaller lakes (less than 100 acres) from consideration. Consequently, these estimates are very conservative.

[c] The mileage of contributing streams and rivers was calculated from the state's total drainage area (Column 2) using 0.919 as the national average of the ratio of total channel length to drainage area. This relationship was derived from estimates given in L. B. Leopold et al., Fluvial Processes in Geomorphology, W. H. Freeman and Co., 1964), pp. 140-142.

[d] Excludes Lake Champlain and reservoirs on the Connecticut River.

[e] Information from the Tennessee Valley authority; excludes most lakes not owned by the T.V.A.

[f] State inventory excludes lakes with surface areas less than 100 acres.

[g] Oregon information includes all lakes having a surface area greater than one acre.

TABLE A-2. ESTIMATE OF POPULATION RESIDING WITHIN FIFTY AND FIVE MILES OF AT LEAST ONE PUBLICLY OWNED LAKE[a]

State	Total Land Area (1000 mi^2)	Population (1000's)[b]	Affected Land Area[c] (1000 mi^2)		Affected Population[d] (1000's)	
			50 mi	5 mi	50 mi	5 mi
Region I						
CT	4.9	3,100	all	4.1	all	2,635 (85)
ME	30.9	1,058	all	27.8	all	952 (90)
MA	7.8	5,812	all	5.1	all	3,778 (65)
NH	9.0	811	all	7.7	all	690 (85)
RI	1.0	931	all	1.0	all	885 (95)
VT	9.3	472	all	4.6	all	236 (50)
Region II						
NJ	7.5	7,333	all	2.6	all	2,566 (35)
NY	47.8	18,075	all	38.3	all	14,460 (80)
Region III						
DE	2.0	579	all	<0.1	all	12 (35)
MD and DC	10.0	4,833	5.8	1.2	2,819 (58)	580 (12)
PA	45.0	11,864	all	33.7	all	8,898 (75)
VA	39.8	4,980	37.8	8.0	4,727 (95)	996 (20)
WV	24.1	1,799	all	2.4	all	180 (10)
Region IV						
AL	50.7	3,616	49.6	7.1	3,534 (98)	506 (14)
FL	54.1	8,283	48.3	10.8	7,394 (89)	1,657 (20)
GA	58.1	4,931	49.9	8.7	4,238 (86)	740 (15)
KY	39.6	3,388	38.5	5.7	3,286 (97)	484 (14)
MS	47.3	2,342	46.6	6.6	2,310 (99)	328 (14)
NC	48.8	5,441	48.0	3.9	5,349 (98)	435 (8)
SC	30.2	2,816	27.4	3.6	2,559 (91)	338 (12)
TN	41.3	4,174	41.1	6.9	4,156 (99)	696 (15)
Region V						
IL	55.7	11,206	all	8.4	all	1,681 (15)
IN	36.1	5,309	35.5	4.3	5,217 (98)	637 (12)
MI	56.8	9,116	all	48.3	all	7,749 (85)
MN	79.3	3,916	all	43.6	all	2,154 (55)
OH	41.0	10,735	all	10.2	all	2,684 (25)
WI	54.5	4,577	51.8	21.8	4,357 (95)	1,831 (40)
Region VI						
AK	51.9	2,107	51.7	7.3	2,096 (>99)	295 (14)
LA	44.9	3,804	44.1	5.4	3,735 (98)	456 (12)
NM	121.4	1,144	97.8	4.9	921 (80)	46 (4)
OK	68.8	2,711	67.9	9.6	2,676 (99)	380 (14)
TX	262.1	12,245	243.2	21.0	11,360 (93)	980 (8)

TABLE A-2. ESTIMATE OF POPULATION RESIDING WITHIN FIFTY AND FIVE MILES OF AT LEAST ONE PUBLICLY OWNED LAKE[a] (CONTINUED)

State	Total Land Area (1000 mi^2)	Population (1000's)[b]	Affected Land Area[c] (1000 mi^2) 50 mi	Affected Land Area[c] (1000 mi^2) 5 mi	Affected Population[d] (1000's) 50 mi	Affected Population[d] (1000's) 5 mi
Region VII						
IA	55.9	2,861	52.2	4.5	2,669 (93)	229 (8)
KS	81.8	2,280	81.6	9.8	2,273 (>99)	274 (12)
MO	69.0	4,770	64.8	6.9	4,477 (94)	477 (10)
NE	76.5	1,544	76.1	10.7	1,536 (>99)	216 (14)
Region VIII						
CO	103.7	2,541	102.2	7.3	2,504 (99)	178 (7)
MT	145.6	746	141.4	17.5	725 (97)	90 (12)
ND	69.3	643	all	10.4	all	96 (15)
SD	76.0	683	72.8	10.6	653 (96)	96 (14)
UT	82.1	1,203	57.2	8.2	837 (70)	120 (10)
WY	97.2	376	96.1	14.6	372 (99)	56 (15)
Region IX						
AZ	113.4	2,225	88.8	5.7	1,777 (80)	117 (5)
CA	156.4	21,202	154.7	46.9	20,982 (99)	6,361 (30)
HI	6.4	868	0.6	0.1	89 (10)	17 (2)
NV	109.9	590	96.2	7.7	517 (88)	41 (7)
Region X						
AS	569.6	364	280.8	28.5	41 (11)	18 (5)
ID	82.7	814	all	9.9	all	98 (12)
OR	96.1	2,284	90.7	7.7	2,150 (94)	183 (8)
WA	66.6	3,553	66.4	10.0	3,548 (>99)	533 (15)
TOTAL	3,536.8	212,873	3,081.7	647.8	211,517 (99)	70,135 (33)

[a] Estimates of affected land area and population are conservative because lakes less than 100 acres were not shown on the state maps (Rand MacNally Road Atlas, 19).

[b] Population figures were based on County and City Data Book, 1977, U.S. Department of Commerce, Bureau of the Census.

[c] This column includes the surface area of all public lakes in each state and the associated land areas which form a fifty and five mile perimeter around each lake (as planimetered from the Rand MacNally Road Atlas 19). No land area was counted twice.

[d] Number in parentheses is percentage of total population.

TABLE A-3. DISTRIBUTION OF URBAN, RURAL, AND COASTAL PUBLIC LAKES

State	State Total	Number of Urban Public Lakes (% State Total)[a]	Number of Rural Public Lakes (% State Total)	Number of Coastal Public Lakes (% State Total)[b]
Region I				
CT	142	11 (13.2)	131 (86.8)	123 (86.6)
ME	3,000	0 (0)	3,000 (100)	2,977 (99.2)
MA	1,302	36 (2.8)	1,266 (97.2)	1,278 (98.2)
NH	978	0 (0)	978 (100)	19 (1.9)
RI	5	5 (100)	0 (0)	5 (100)
VT	19	0 (0)	19 (100)	NA
Region II				
NJ	375	117 (31.2)	258 (68.8)	367 (97.9)
NY	2,822	129 (46.0)	2,693 (54.0)	51 (1.8)
Region III				
DE	30	3 (10)	27 (90)	30 (100)
MD and DC	12	7 (58.3)	5 (41.7)	9 (75)
PA	193	19 (9.8)	174 (90.2)	2 (1.0)
VA	19	6 (31.6)	13 (68.4)	5 (26.3)
WV	34	4 (11.8)	30 (88.2)	NA
Region IV				
AL	83	11 (13.2)	72 (86.8)	2 (2.4)
FL	1,054	737 (69.9)	317 (30.1)	873 (82.8)
GA	74	12 (16.2)	62 (83.8)	1 (1.4)
KY	817	2 (0.2)	815 (99.8)	NA
MS	107	1 (0.9)	106 (99.1)	1 (1.0)
NC	97	15 (15.5)	82 (84.5)	9 (9.2)
SC	171	50 (29.2)	121 (70.8)	4 (2.3)
TN	177	39 (22.0)	138 (78.0)	NA
Region V				
IL	271	17 (6.3)	254 (93.7)	NA
IN	276	21 (7.6)	255 (92.4)	NA
MI	3,326	92 (2.7)	3,234 (97.3)	NA
MN	2,065	115 (5.6)	1,950 (94.4)	NA
OH	207	58 (28.0)	149 (72.0)	NA
WI	871	75 (8.6)	796 (91.4)	NA
Region VI				
AK	344	4 (1.1)	340 (98.9)	NA
LA	157	19 (12.1)	138 (87.9)	31 (19.7)
NM	160	0 (0)	160 (100)	NA
OK	1,894	17 (0.9)	1,877 (99.1)	NA
TX	240	31 (12.9)	209 (87.1)	15 (6.2)

TABLE A-3. DISTRIBUTION OF URBAN, RURAL, AND COASTAL PUBLIC LAKES (CONTINUED)

State	State Total	Number of Urban Public Lakes (% State Total)[a]	Number of Rural Public Lakes (% State Total)	Number of Coastal Public Lakes (% State Total)[b]
Region VII				
IA	88	4 (4.5)	84 (95.5)	NA
KS	91	4 (4.3)	87 (95.7)	NA
MO	102	9 (8.8)	93 (91.2)	NA
NE	224	5 (2.2)	219 (97.8)	NA
Region VIII				
CO	271	76 (28.0)	195 (72.0)	NA
MT	86	0 (0)	86 (100)	NA
ND	211	0 (0)	211 (100)	NA
SD	742	0 (0)	742 (100)	NA
UT	1,863	6 (0.3)	1,857 (99.7)	NA
WY	57	0 (0)	57 (100)	NA
Region IX				
AZ	157	2 (1.3)	155 (98.7)	NA
CA	4,034	225 (5.6)	3,809 (94.4)	23 (0.6)
HI	2	1 (50.0)	1 (50.0)	2 (100)
NV	67	41 (61.1)	26 (38.9)	NA
Region X				
AS	83	0 (0)	83 (100)	178 (38.3)
ID	96	0 (0)	96 (100)	NA
OR	6,619	80 (3.3)	6,539 (96.7)	33 (1.3)
WA	717	421 (58.7)	296 (41.3)	19 (2.6)
TOTAL	36,832	2,527 (6.9)[c]	34,170 (92.4)[c]	6,057 (16.4)

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[a] An urban lake is defined to be any lake within the area compromising of the 120 most-populated Standard Metropolitan Statistical Areas (Statistics for State and Metropolitan Areas; U.S. Department of Commerce, pages 794, 896-901).

[b] Coastal lakes are located within 50 miles of the Atlantic or Pacific Oceans, or the Gulf of Mexico.

[c] The total of urban and rural is 36,697; 135 lakes could not be classified.

Appendix B

CLEAN LAKES PROJECT SUMMARIES

TABLE 4-1. DISTRIBUTION OF URBAN, RURAL, AND COASTAL PUBLIC LAKES (CONTINUED)

State	Total Lakes	Number of Urban Public Lakes (% State Total)[a]	Number of Rural Public Lakes (% State Total)	Number of Coastal Public Lakes (% State Total)[b]
Region VII				
IA	[illegible]	[illegible]	[illegible]	[illegible]
KS	[illegible]	[illegible]	[illegible]	[illegible]
MO	[illegible]	[illegible]	[illegible]	[illegible]
NE	[illegible]	[illegible]	[illegible]	[illegible]
Region VIII				
CO	[illegible]	[illegible]	[illegible]	[illegible]
MT	[illegible]	[illegible]	[illegible]	[illegible]
ND	[illegible]	[illegible]	[illegible]	[illegible]
SD	[illegible]	[illegible]	[illegible]	[illegible]
UT	[illegible]	[illegible]	[illegible]	[illegible]
WY	[illegible]	[illegible]	[illegible]	[illegible]
Region IX				
AZ	[illegible]	[illegible]	[illegible]	[illegible]
CA	[illegible]	[illegible]	[illegible]	[illegible]
HI	[illegible]	[illegible]	[illegible]	[illegible]
NV	[illegible]	[illegible]	[illegible]	[illegible]
Region X				
AK	[illegible]	[illegible]	[illegible]	[illegible]
ID	[illegible]	[illegible]	[illegible]	[illegible]
OR	[illegible]	[illegible]	[illegible]	[illegible]
WA	[illegible]	[illegible]	[illegible]	[illegible]
TOTAL	[illegible]	[illegible]	[illegible]	[illegible]

[a] [illegible]

[b] Coastal lakes are located within [illegible] of the [illegible], or the Gulf of Mexico.

[c] [illegible]

This Appendix contains summaries of the 28 projects reviewed during the course of the benefits assessment. They are arranged in alphabetical order. Each one follows the same general outline:

- Lake location, description, and setting
- Project objectives
- Brief project description
- Identification and discussion of benefits
- Tabular summary of benefits
- List of data sources
- Date of site visit.

Some of the information in each summary was developed from field investigators' observations and reviews of EPA and grantee project files. General information from these sources has not been footnoted. Some material was obtained from published reports which are identified by footnotes corresponding to numbers in the data source list at the end of each summary. Many specific items of information were gathered in interviews with members of various state and local agencies and private groups. The sources of these items are identified, by organization, using the same footnoting convention. Records of the discussions with each individual are on file at JACA Corp.

The UDV method was applied in estimating recreational benefits at most sites. In individual summaries, the points assigned in deriving the unit day values are reported in the same order as in the UDV tables in Appendix C, using the following convention:

Experience/Availability/Capacity/Accessability/Quality = Total

For example, UDV at Steinmetz Pond is $1.93 (4/3/7/17/10 = 40).

ANNABESSACOOK LAKE AND COBBOSSEE WATERSHED

Cobbossee Watershed is a 28 lake watershed in Kennebec County, Maine. Slightly west of Augusta, it is a residential area for local people in the ten municipalities within the watershed, a bedroom community for part of Augusta, and a summer home for others. The winter population is 25,550. In summer, population increases 60 percent to 40,880[1,2].

Annabessacook Lake, which covers 1,420 acres, is the most northern of the three eutrophic lakes that are being funded under Section 314. The other two are Cobbossee Lake (5,583 acres) and Pleasant Pond (746 acres).

The purposes of 314 funding of the watershed are to improve water quality in the three eutrophic lakes and to alleviate non-point agricultural runoff to all of the lakes in the watershed by encouraging the construction of manure storage facilities.

The Cobbossee Watershed District is well underway in its program. Annabessacook Lake, which suffered from excessive phosphorus enrichment and dense algal blooms, has been treated with 100,000 gallons of aluminum sulfate and sodium aluminate. Visibility has improved dramatically - from 77 days with less than 2 meters of visibility in 1977 (before treatment) to 0 days of less than 2 meters of visibility in 1979 (after alum treatment and manure pit construction).[1] Local dairy and poultry farmers have been educated in the relationship between manure management and water quality. Almost all of the 39 farmers in the watershed have built or are building manure storage facilities.[1,8]

The benefits of 314 funds are in many areas - recreation, property values, aesthetics, local economy, agriculture, education, and R&D.

Recreation

Recreational opportunities on the 31 lakes include: swimming, boating, fishing (open-water and ice-fishing), water skiing, ice skating, and seaplanes. Activities have been sharply reduced in summer due to poor visibility.

No records are available of the number of people who used Annabessacook either before or after "clean-up". The local consensus is that probably the only users in the recent past have been people with homes on Annabessacook. The same reasoning applies to the other two eutrophic lakes. (The number of people in the first 1,000 feet from the shoreline on Annabessacook is 681; on Cobbossee, 2,729; and on Pleasant Pond, 419.[1]) This usage only by property owners is due to the fact that there are facilities on nearby lakes (often within walking distance), that are mesotrophic.

With no information on recreational use,[1,4] it would have been impossible to measure recreation except for the fact that local municipal officials were willing to spend time studying property values.[5,6] The information they obtained permitted the use of property values as the primary benefit estimation technique in the analysis.

Aesthetics

The beneficiaries of the improved aesthetics on the three restored lakes in Maine include not only property owners but also any travellers who see them. Route 202, the main road from Augusta to Lewiston-Auburn, passes two eutrophic lakes (Annabessacook and Cobbossee) as well as several "clean lakes" in the same watershed.

No data are currently available on the amount of traffic per day on Route 202. The Cobbossee Watershed District has requested the State of Maine to collect this information for EPA's use in the future.[1] The number is presumably large -- netting out, of course, current property owners (which involves double counting). Once a quantity (number of vehicles per day) is obtained, a "price" per user hour can be estimated for the improved aesthetics to non-property owners. Given this, a dollar value can be assigned to two things:

- The protection of existing aesthetic amenity
- The improved aesthetics.

At present, however, the only aesthetic benefit measured is that which manifests itself in property value increase.

Economic Effects

Lake restoration projects usually involve the services of highly trained personnel, and this one is no exception. In addition, however, the construction of the manure pits uses unskilled and semi-skilled labor. Cobbossee Watershed District sent questionnaires in December to each of the nine builders of these pits. A question asked was how many man-days of unskilled labor were used - and whether this contributed to a reduction in area unemployment (whether they would otherwise have been employed). Total man-days of unskilled labor to-date have been 430. Of these, about 150 man-days are for work they would not otherwise have had.[1] The income effect of this increase in employment, at the minimum wage rate is:

150 x 8 hours per day x $3.10 = $3,720.

This will continue as more manure pits are built in the next two years.

In addition, local suppliers of steel and concrete report increases in total sales due to the pits of $53,506 (concrete) and $35,616 (steel). This totals $89,122.

Agriculture

The manure storage facilities - in addition to their main purpose of reducing runoff from agricultural operations - also benefit the farmer. Among the benefits are: savings of time and aggravation, first in collecting and then in spreading the manure; reduced tractor cost (depreciation and fuel); and especially a reduction in the need to purchase additional commercial fertilizer because fewer nutrients are lost from the manure. The sizes of these benefits to the farmer are considered enough to justify the costs, over some pay-off period which is as yet undetermined. Quantification of any savings is not yet possible, because farmers have had at most one year's experience with this program.[1,3,8]

Property Values

It has been demonstrated that lake restoration increases the value of shoreline property. This is because of improvements in recreational opportunities and also in aesthetics. The result for property owners will be a one-time unrealized capital gain which will accrue to them when they sell. The magnitude of the gain provides a measure of project benefits which are capitalized in the property values.

The improvement in property values from lake restoration will also increase local municipal tax revenues each year. When municipalities receive the implied increases depends on the rapidity with which they respond to lake improvement by reassessing the property. Generally, of course, there are institutional lags in both directions -- a slowness to respond either to declines or increases in values.

This increase in municipal revenues from lake improvement - whatever the timing - assumes, of course, that the tax rate over all property in the community remains constant. That is, the municipality does not keep total tax collections constant after restoration by reducing revenues on non-lake property. A constant tax rate is a reasonable assumption in the present economic situation. There has been -- and is likely to continue to be -- a high rate of inflation partly attributable to rising fuel costs and partly attributable to the feed-back from this to wages (via Consumer Price Index adjustments).* It is unlikely any municipality can afford to "refund" any gain in revenues to anyone. What the affected communities in Kennebec County, Maine do, of course, will only be known ex post.

The City of Winthrop, Maine, was selected for some insight into past deterioration of property values on Annabessacook and in Cobbossee Watershed. This is because it contains portions of the two largest lakes undergoing restoration (Annabessacook and Cobbossee) as well as three "clean" lakes. The tax assessor and local codes enforcement officer compared various measures of property values on these lakes. Among these were: number of building permits issued in recent years; turnover in homes; the price of one foot of undeveloped shoreline on different lakes; and the (implied) price per foot of shoreline on different lakes of developed property based on sales made. By all measures, the housing markets on Annabessacook and Cobbossee were "depressed".

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*Thus, this argument abstracts from the current high interest rates, which in turn affect the CPI through the mortgage rate. Even without that, municipalities are short of funds.

The choice of (implied) lower property values is critical because of length of shore. Data suggested that Annabessacook shoreline property was selling for anywhere from $25 to $75 per foot compared to $150 per foot on other lakes. The minimum gain ($75 compared to $150) is used here with the result that unrealized capital gain from Annabessacook restoration to property owners is:

$150 - $75 change in shoreline value x 71,280' of shoreline = $5,346,000.

Winthrop has a 30 mill tax rate. Depending on size of the changes, Winthrop would gain from $54,000 to $159,000 per year in taxes. Only 29 pecent of Annabessacook lies in Winthrop, the bulk (71%) being in Monmouth. The annual increase in tax revenues from restoration of Annabessacook to Winthrop and Monmouth is from ($54,000 + $132,207) = $186,207 per year to ($159,000, + $389,276) = $548,276 per year. Since each of these towns in the watershed contributes .0005 of its taxes from shoreline property back to the Cobbossee Watershed District, this implies that an additional $93 (.0005 times $186,207) will be available each year to the district to protect future water quality.

The benefits are staggering when one considers Cobbossee Lake, where restoration is expected to be completed in 1981 or 1982. In 1979 dollars, the expected gain to current property owners is $17,028,000 (that is, $75 a foot of shoreline x 227,040 feet of shore). Annual increases in tax revenues - if proportioned from the $186,207 on Annabessacook - become $593,104. The watershed district receives $296.55 each year.

Education, Research and Development

There are several educational and R&D benefits that will result from 314 funding:

1. There will be an advance in knowledge about methods used to attack phosphorus loadings in a chain of lakes.[1,7]
2. The applicability of the Wisconsin experience to Maine - i.e., the use of manure storage facilities to control non-point sources of runoff - will be investigated. A related issue is that soil conservation experts feel it will also help them to evaluate "economies of scale" in manure pits. That is, what is the "cut-off point" in terms of farm size at which benefits no longer exceed costs.[8]
3. The ability of Cobbossee Watershed District and its professional staff - in cooperation with DEP in Maine - to put together this 314 proposal may have a "demonstration effect" on other watersheds in Maine. One advantage of Cobbossee has been that it has its own funding, through local municipalities which contribute part of their taxes annually to maintain water quality.[1,2]
4. There is an educational value to the country of knowing that there are in Maine exceptionally high standards for water quality. Property values in Maine decline - and the recreational experience is sharply reduced - by levels of water quality that may be acceptable elsewhere.
5. Each year students from various universities have studied aspects of this large watershed as part of their training.

SUMMARY OF BENEFITS

ANNABESSACOOK LAKE AND COBBOSSEE WATERSHED

Recreation	
Measured through changes in property values	+
Aesthetics	
Owners: Measured through changes in property values	
Others: large but presently unmeasurable	+
Local Economy	
Employment and income added: unskilled labor	$ 3,700**
Sales by local business of steel and concrete	89,100*
Property Values	
Municipal tax revenue increases:	
Annabessacook	
Annual additional tax revenues	186,200
Cobbossee	
Annual additional tax revenues	593,100
Benefits Capitalized in Property Values	22,374,000*
Agriculture	+
Education and R&D	+
Total First Year	$23,246,100
Total Discounted Benefits	$26,639,500
314 Grant Amount	$ 467,906.50

*One time cost, applied to first year only.
**For three years only.

Data Sources:

1 Cobbossee Watershed District
2 Maine Department of Environmental Protection, Division of Lakes and Biological Studies
3 Clemente Farms
4 Maine Department of Fish and Wildlife
5 City of Winthrop, Code Enforcement Officer
6 City of Winthrop, Property Tax Officer
7 EPA, Region I
8 U.S. Soil Conservation Service

Date of Site Visit: December 19, 1979.

LAKE BOMOSEEN

Lake Bomoseen occupies 2,634 acres at Castleton, Rutland County, Vermont. It is primarily a seasonal resort area; a state park with beach is heavily used during the 100-day season between Memorial Day and Labor Day, and there are approximately 800 private properties around the lake. Lake uses include water-skiing, boating, swimming, fishing, limited ice fishing, skating, camping, and aesthetic enjoyment.

The objectives of the project were to remove weeds from 123 acres, thus eliminating aesthetic problems (odors, especially of dead fish trapped in the weeds) and improving swimming and boating, and in so doing, to reduce the nutrient pool available to aquatic plants and algae. Weed harvesting equipment was purchased and weeds were harvested during the summers of 1977, 1978, and 1979. The crop of weeds harvested diminished with each succeeding year, and 1979 was the first year in recent history without a serious algal bloom.[2] Lake Association and town officials estimate an annual operating cost of $10,000 for harvesting, which must be deducted from benefits.

The principal benefits have been in the areas of recreation, aesthetics, research and development, and community activities. A small incremental benefit was achieved in pollutant reduction, and a significant benefit accrued to property owners. The project has been beneficial from a research and development standpoint as well. These benefits are discussed briefly below and summarized in the table at the end of this section.

Recreation

One of the portions harvested is the swimming area at the state park, which has recorded the following use days:[1]

	1974	1975	1976	1977	1978	1979
Day use:	7,613	12,414	6,548	6,853	7,154	6,704
Camping:	17,679	14,372	14,434	13,594	13,404	11,620

The decline in 1979 is blamed on the gasoline shortages. More detailed statistics show that between 1976 and 1978, out-of-state visitors accounted for 75 to 80 percent of the camping use volume, while in 1979 the out-of-state volume decline by 2,400 and represented only 70 percent of camping.[1] In-state camper totals increased by 700 people in 1979.

In calculating recreational benefits, it was assumed that the project is protecting existing levels of use. The grantee estimates that 7,500 people use the lake on a peak day, including residents, guests, and park visitors.[1] Assuming 4 people/property x 800 properties are residents and their guests, 4,300 are visitors. This can be converted to annual non-resident use by multiplying by 50, in accordance with accepted estimation techniques (see Appendix C) for a total of 215,000 annual use-days. Winter users add an additional amount not included in the estimate; better summer conditions promote more winter use as well. Using the UDV method, a value of \$2.61 (10/10/14/18/15 = 67) per use-day of general recreation has been assigned to Lake Bomoseen, for a total annual non-resident recreational benefit of \$561,200.

Recreational benefits to residents can be assumed to be capitalized in property values and ideally should be estimated through property value increases. However, no data were available for that purpose. Consequently, benefits to residents were calculated for a 100-day season using the same UDV but assuming that each day of residence is equivalent to three non-resident user-days.

$$3 \times 3,200 \times 100 \times 2.61 = \$2,505,600.$$

This entire amount, \$3,066,800, cannot be assigned to the Clean Lakes Program. A conservative estimate is that recreational use would decline at the rate of 2 percent annually because of weed growth in the absence of the grant. Consequently, the benefit in the first year is \$61,300 of recreation protected. In the second year, an additional 2 percent is protected, and so on, until in the tenth year, \$613,000 is the future value being protected.

Aesthetics

Aesthetic benefits have not been separately quantified as they are included, to a great extent, in recreation. However, it is worth noting that murky water and foul odors in near-shore areas have been eliminated and that of 211 persons questioned by the Lake Bomoseen Association and the Vermont Department of Water Resources, 185 believed that weed harvesting had improved water quality for recreation and 183 agreed that the Federal government should continue to fund such programs.

Research and Development

Lake Bomoseen has been visited by other groups considering harvesting projects. Research on nutrient cycling in the lake is ongoing.

Community Environmental Activities

Since harvesting began, business memberships in the Lake Bomoseen Association have increased from 6 to 50 and regular membership from 210 to 500.[2] This is a good measure of the extent of community concern with lake quality and environmental protection.

SUMMARY OF BENEFITS

LAKE BOMOSEEN

Recreation Protected	$ 61,300*
Aesthetics	+
Research and Development	+
Community Activities	+
Less: Harvesting Costs	- 10,000
Total First Year	$ 51,300
Net Present Value for 10 Years	$1,830,500
314 Grant Amount	$ 74,640

*Increases by this amount each year.

Data Sources:

1. Vermont Department of Water Resources
2. Lake Bomoseen Association
3. Town Manager, Castleton, Vermont

Date of Site Visit: December 20, 1979

BUCKINGHAM LAKE

Buckingham Lake is a four acre man-made lake located in a residential neighborhood within Albany, New York. The population within the immediate lake vicinity is approximately 5,000, or 4.5 percent of Albany's total population of 109,900. The neighborhood within which the lake is located is one of few in Albany under development, as distinct from redevelopment supported by government funding.

Before the restoration project was initiated, the lake was "reduced by severe silting, accumulation of organic debris and aquatic growth to a very shallow depth completely discouraging any recreational activity. Signs of sanitary sewage inflow (were) also visible."[4] The lake project entailed draining the lake and, via excavation, removing accumulated silt and muck.[1]

The project was completed, with the lake filling after drainage, on February 5, 1977. However, the lake is still eutrophic, with non-limiting concentrations of nitrogen and phosphorus.[1] The volume of nearby residential construction is a factor in declining lake quality. Sediment due to erosion of lands at the southwest end which are under residential construction, as well as surface drainage, continues to enter the lake through two major stormwater outfalls constructed in 1976 to service in new subdivision.

Three types of benefits resulted from the improvement:

- Recreational benefits, due to increased fishing, skating, strolling and picnicking on or near the lake
- Aesthetic benefits, which improved the visual amenity of the area
- Some educational and economic benefits, due to Youth Conservation Corps work at the lake in 1977-1979 and the hiring of elderly men for lake area maintenance.

As the city bought seven areas adjacent to the lake to serve as a buffer and for recreational uses,[3] general area improvement, consisting of the siting of benches and the planting of a small garden, contributed to some share of the benefits.

Recreation and Aesthetic Benefits

Recreation uses of the lake before the program were primarily passive uses and skating. There was no swimming, boating, or fishing. Recreation uses after the program included increased passive recreation (strolling and picnicking), as well as increased use of the area for play by neighborhood children.[7]

Major improvements were in skating and fishing uses. The improvement increased the size of the skating area.[7] The improvement was a factor in the stated decision to stock the lake in 1977, as an antecedent step to the Urban Fisheries Program, beginning in 1980. Under the Fisheries Program, if the city of Albany decides to undertake a stocking program, there would be an estimated 7,200 annual angler-trips on the lake for 1980-87, with a large proportion of the anglers less than sixteen years old.[9] It has been estimated that the fisheries program will cost $.53 per recreation day (June through August), and that it will be continued after 1987.

The unit day value for fishing at Buckingham Lake has been estimated at $1.99/(5/3/5/10/2 = 25). For at least 1980 through 1987, the value of annual fishing benefits, entirely due to the improvement, can be estimated as

$$7,200\ (1.99 - .53) = \$10,512.$$

In the absence of other usage records, a conservative estimate is to assume that, as a result of the improvement, each of the 5,000 neighborhood residents uses the lake one more time a year, excluding fishing trips. At a UDV of $1.56 (25 points), this assumption yields an annual value of new recreational benefits, other than fishing at $7,800. Direct annual recreation benefits due to the improvement sum to $18,300.

Economic and Education Benefits

Albany has a relatively low unemployment rate of 6 percent. The project created some employment, as elderly men were hired by the Recreation Department for general lake area maintenance.[7] The project also created employment and education benefits related to Youth Conservation Corp lake area work in the summers of 1977-1979.[7] Thirty enrollees worked on painting, clearing debris, and erosion control. With activities in Washington Park Lake, these activities represented 50 percent of the YCC's programs.

SUMMARY OF BENEFITS

BUCKINGHAM LAKE	
Recreation and Aesthetics	$ 18,300
Economic	+
Education	+
Total First Year	$ 18,300
Total Discounted Benefits	$127,734
314 Grant Amount	$ 23,250

Data Sources:

1. Project Report Restoration of Buckingham Lake, Albany County, New York and Post-Restoration Monitoring of Chemical, Physical, and Biological Lake Characteristics (1977).
2. Environmental Protection Agency Clean Lakes Office
3. EPA Region II Clean Lakes Coordinator
4. New York Department of Environmental Conservation
5. Albany Budget, FY 1979-1980
6. Albany Chamber of Commerce Statistics
7. City of Albany Departments: Assessment
   Recreation
   Planning
   Human Resources
8. Albany County Public Health Department
9. New York State Urban Fishing Program information.

Date of Site Visit: January 7, 1980

CHARLES RIVER LOWER BASIN

The Charles River Basin, with a surface area of 696 acres, is the major fresh-water recreational area for the greater Boston community. The Basin is heavily utilized throughout the year for a variety of recreational activities, the most famous being sailing and sculling. Others are boating, fishing, public concerts, strolling, cycling and jogging, sunbathing and informal relaxing, sailing toy boats in a lagoon on the Embankment, and informal picnicking. The Museum of Science is located on the Basin, and the water can be seen from many of Boston's bridges and highways. The Basin is easily and quickly accessible by walking or by private or public transportation to anyone in the Boston Metropoliton Area. This includes from 1,174,600 to 2,050,500 people, depending on the definition used.[3] One stop on the MBTA, "Charles", is one block from Community Boating, the Hatch Shell, and the Embankment.

The 314 grant, which is largely expended, was used to destratify the Basin by induced circulation using compressed air. The purposes of this project were (1) to reduce odors from hydrogen sulfide production, and hence, increase the pleasure of current Basin-related recreational opportunites, and (2) increase oxygen at lower levels of the Basin to make the situation more tolerable for game fish.

The 314 funding is only a small part of major Federal and local efforts in recent years to produce a "joint product" which would result in a higher quality of water in the Charles River. Other funding was used to solve sewer problems (201 grants) and to build a new dam (The U.S. Army Corps of Engineers).[1,2] The result of these efforts has been to improve water quality in the Basin from a "D" to a "C" rating, according to the Massachusetts classification scheme.[12] This indicates that the water is now suitable for boating and fishing but not for swimming.

The benefits of destratification (and other Federal and local work) are in several categories: recreation, aesthetics, educational, and research and development.

Recreation and Aesthetics

Using the UDV method, the Charles Basin is assigned an initial value of $2.39 per user day (11/14/10/18/2 = 55). This relatively high rating - even before restoration - is due to its excellent sailing and sculling facilities, and to its accessibility. A problem in measuring recreational benefits is the difficulty of clearly separating the benefits of 314 funding from other aspects of the "clean-up", because the projects are interrelated in time and design. The compromise chosen is the following:

- Recreation: The assumption here is that the Basin has improved from "11" points to "16" points in "Recreational Experience", or 9.5 cents per user day.
- Aesthetics: The assumption is that the Basin has improved from "2" points to "5" points in "Environmental Quality", or 5.4 cents per user day.

Second, some recreational experiences are more affected by bad odor or low dissolved oxygen than others. Fishing is obviously affected, but no data are available on the numbers of fishermen. It is assumed here that - by their nature - sailing and sculling are affected the full 9.5 cents per user day by bad odors. On the other hand, it is assumed other recreational users are not as bothered as sailors by bad odors, and an average of the recreational value (9.5¢) and aesthetic value (5.4¢) is used to quantify other recreation activities. This is 7.4 cents.

Third, the length of the user day is assumed to be six hours. This is critical in cases where data are provided in hours or minutes. A clear example is cars driving along the Basin, where the assumption is that each car spends 1/2 hour on Storrow or Memorial Drives but only 10 minutes on a bridge connecting Cambridge with Boston.

A. Sailing and Sculling

The major recreational activities of high - and perhaps unique - value on the Charles Basin are sailing and sculling. These are offered by three groups, the most important of which is Community Boating, Inc., a non-profit organization under the jurisdiction of the MDC and open to any member of the Boston Community who wishes to sail. A second group includes the universities: MIT, Boston University, and Harvard. The third is the group of private clubs, the Cambridge Boat Club being best known because of the annual Head-of-the-Charles Regatta. The benefits of water-improvement to existing users of the sailboats and shells we listed by group, and by season:

1. Community Boat Club (Sailing Only)[5]

Peak season: June and July	
Weekends:	
[(113 boats x 2 passengers/boat x 2 days/week x 9 weeks) x (1 user-day)] x $.095 =	$ 386.46
Weekdays:	
[(113 boats x 2 passengers/boat x 5 days/week x 9 weeks) x (.5 user-day)] x $0.095 =	$ 483.08
Other 5 months: April, May, August, September, October.	
Weekends:	
[(113 boats x 2 passengers/boat x 2 days/week x 22 weeks) x (.5 user-day)] x $.095 =	$ 472.34
Weekdays:	
[(113 boats x 2 passengers/boat x 5 days/week x 22 weeks) x (.25 user-day)] x $.095 =	$ 590.42
Subtotal	$1,932.30

2. Universities (Shells and Sailboats)

a. MIT:[13] April 1 to November 15	
Shells:	
160 people/day x 229 days x .3 user-days x $.095 =	$1,044.24
Sailboats:	
300 people/day x 229 days x .3 user-days x $.095 =	$1,957.95
b. Boston University:[14] April 1 to November 15	
Shells:	
150 people/day x 229 days x .3 user-days x $.095 =	$ 978.98
Sailboats:	
100 people/day x 229 days x .3 user-days x $.095 =	$ 652.65

c. Harvard University:[7]

Shells:	
September 1 to November 30:	
375 people/day x 91 days x .3 user-days x $.095 =	$ 972.56
April 1 to August 31:	
750 people/day x 138 days x .3 user-days x $.095 =	$2,949.75
Sailboats:	
April 1 to November 15:	
340 people/day x 229 days x .3 user-days x $.095 =	$ 261.06
Subtotal	$8,817.19

3. Private Clubs:

The previous information on Community Boating and the Universities sets the rowing and sailing experience in some perspective. No attempt was made to obtain a precise count on private clubs. An exception is the Head-of-the-Charles Regatta. Participants come from all over the world, and it has been called "the biggest rowing event in the world". In 1975, there were 2,577 rowers in 590 boats.[1] For the participants in the rowing, the value of the improved Charles to existing rowers is:

(2,577 people x .3 user-days x $.095) = $73.44

The total value of benefits to existing sailing and rowing users of the Basin is $10,822.93. This is an underestimate, because all users (especially those belonging to private clubs) are not quantified.

B. Other Boating

There are two other types of boating by existing users of the Basin that can be quantified. These are:

1. Pleasure craft (all sizes) coming from Boston Harbor through the Locks of the Charles River Dam.[8]
   (15,538 pleasure craft x 3 passengers/boat x 1 user-day x $.074) = $3,449.49

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*113,152 is the sum of all user days of the Basin for sailing and rowing purposes. That is, (113 x 2 x 9 x 1) + (113 x 2 x 5 x 9 x .5) + ...

2. Charles River Cruises, Inc., is a sightseeing boat on the Basin.[1] (4,489 passengers x .5 user-days x $.074) = $166.09.

The total value of these benefits to existing users is: $3,615.58.

C. Fishing

One result of the destratification project will be an improvement in the relative amounts of different kinds of fish that are in the Basin. The increase in dissolved oxygen at lower levels will make conditions more tolerable for all fish. This, combined with the new fish ladder in the new Charles River Dam, will make it possible for certain anadromous fish to utilize the Basin. A site is being created for and stocked with shad at the further end of the Basin (near Watertown Dam).[1,9] No numbers are available on the current number of fishermen, so this benefit is not quantified.

D. All Other Recreation

The total number of other recreational users of Basin-related activities has not been estimated by Boston. There are estimates for three activities in the Basin.[1] The total value of benefits to these existing users is:

1. Viewing of the Head-of-the-Charles Regatta on the third Sunday in October (50,000 - 75,000)
   (62,500 people x 1 user-day x $.074) = $4,625
2. Total Hatch Shell attendance for free, outdoor concerts (last estimate: 1977)
   (607,000 people x .33 user-day x $.074) = $14,822.94
3. Museum of Science attendance (amount of time spent "outside" the building assumed to be 1/2 hour)
   1,000,000 people x .08 user-day x $.074 = $5,920

The total new benefits to existing users are thus: $25,367.94.

Aesthetics

Major road traffic in the Boston metropolitan area exists within sight (and smell) of the Basin itself. Two major roads for commuters to Boston or Cambridge from the suburbs are separated from the Basin by a narrow strip of grass. Three major bridges connect the Cambridge (and northern Massachusetts) side with the Boston side. The MDC has provided estimates of average daily traffic per day for the Charles River Basin along these routes.

In general, the observations of drivers are probably indirect - in terms of the number of sailboats on the Basin or the number of people enjoying themselves in other Basin-related activities. (Before the massive clean-up, drivers may have noticed debris, refuse, or obnoxious odors.) Thus, benefits to drivers are primarily aesthetic and assigned a value of $.054 per user-day.

Assuming (1) there is only one driver in each vehicle (no passengers), and (2) either each vehicle spends 1/2 hour on a drive per day or 1/5 of an hour on a bridge; the aesthetic experience to existing drivers, by location, is:

1. Storrow Drive
   (100,000 cars/day x 365 days/yr x .08 user-days x $.054) = $157,680
2. Memorial Drive
   (50,000 cars/day x 365 days/yr x .08 user-days x $.054) = $78,840
3. Harvard Bridge
   (20,000 cars/day x 365 days/yr x .03 user-days x $.054) = $11,826
4. Longfellow Bridge
   (30,000 cars/day x 365 days/yr x .03 user-days x $.054) = $17,739

The total aesthetic benefit to drivers of a cleaner Charles is $266,085.

Educational and Research and Development

Destratification of the Charles River Basin in and of itself is a relatively straightforward matter. Although the results in Boston are of some interest, they are not the major educational benefits from the

314 project. The significance of this project is its demonstration of a coordinated approach to an enormous water quality problem in an urban area. Although it is impossible here to assess the benefit/cost ratio of the total "package", two unquantifiable benefits of a general nature are relevant. One is that whether they use it or not, Bostonians derive some satisfaction from the knowledge that their Basin is improved. Another is that all Americans derive some benefit from the fact that Boston had deteriorated water quality, and that this deterioration has been reversed.

SUMMARY OF BENEFITS

CHARLES RIVER BASIN

Recreational		
Sailing and sculling	$10,822.93	
All others	28,983.52	$ 39,800
Aesthetics		266,000
Educational and Research and Development		+
Total First Year		$ 327,600+
Total Discounted Benefits		$2,286,600
314 Grant Amount		$ 387,163

Data Sources:

1. Metropolitan District Commission (MDC)
2. EPA - Region I
3. Metropolitan Area Planning Council
4. Charles River Watershed Association
5. Community Boating, Inc.
6. Cambridge Boat Club
7. Harvard University Crew Director
8. Superintendent, Charles River Dam
9. Massachusetts Department of Fish and Wildlife
10. MDC Police
11. Massachusetts Department of the Census
12. Plus various published references listed on following pages
13. MIT Crew Director
14. Boston University Crew Director.

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CLEAR LAKE

Clear Lake, 614 acres in surface area, is one of the small lakes associated with glacial moraine in southeastern Minnesota. It is located within the town of Waseca, in the County of Waseca, 75 miles south of Minneapolis. The population of the town is approximately 8,000 and there are approximately 8,000 residents within the county.

In January of 1976, the murky waters of Clear Lake came under direct attack when the Waseca City Council approved a grant application to clean up the lake. This was then estimated to cover 50% of the cost of diverting a storm sewer which carries runoff and some sanitary waste from Waseca into Clear Lake. Many storm sewers also drain into Loon Lake which is connected underground with Clear Lake. The proposal called for diverting these waters through a ditch to a slough which will be seeded with reed canary grass in order to reduce runoff. At the north end of the slough, a sluice gate will be placed to allow water to run into Rice Lake to the north if water level in Loon Lake becomes too high following a storm. Two pumps will be placed at the end of the main ditch in order to pump water back into Clear Lake during periods of high water because the lake is higher than the slough. The foregoing method should allow substantial reduction in nutrient and sediment loading to Clear Lake as a result of this biological filtration and should aid in maintaining the lake in more aesthetically pleasing condition by reducing the causes of cultural eutrophication which has bedeviled it since the early 1900s.

The project's primary benefits will be in the categories of recreation, aesthetics, public health, economic development, pollutant reduction and reduced lake management costs.

Recreation

Reduction of nutrients and sedimentation input to Clear Lake will allow continued recreational use and amelioration of the conditions associated with eutrophication of Clear Lake which is an integral part of this city culturally as well as aesthetically. Currently, at least 13,000 user days are calculated for Clear Lake including angling, boating, ice fishing, camping, swimming, and a park setting for both regional and out of state individuals, the latter reportedly coming from Iowa for free outdoor recreation. This seems to be the peak demand for recreation at the lake, and a large increase is unlikely. Consequently, the project is preserving recreational value which might be lost in 50 more years. Improvements in the lake as a result of project funding will raise the UDV from approximately $2.00 (12/3/7/11/7 = 40) to $2.70 (16/3/10/11/9 = 49). Restoration benefits can thus be calculated as follows:

$ .70 x 13,000 =	$ 9,100	new benefit
$2.00 x 13,000 =	$26,000	benefit protected

The loss of benefit in the absence of the project is assumed to be at the rate of 2 percent annually. Consequently, $520 would be the first year increment protected, $1040 the second year, etc.

Aesthetic Enjoyment

Clear Lake is within city limits of Waseca and is enjoyed by every resident as well as those who appreciate the lake from major roads. If each township resident as well as travelers utilized the lake once each week, 8,000 people x 52 weeks = 416,000 use days. At an average recreation value of $1.07 per use day, the lowest value for a unit day recreation value, a total benefit of 445,120 per year would accrue. This benefit is being protected at the rate of $8,900 per year, calculated as for recreation. In addition, approximately $.04 of new benefit (2 points in environmental quality), or $16,640, is being added through improvement in aesthetic quality.

Economic Development

Benefits of the project will accrue gradually and cannot be quantified directly. First, Waseca is a community with a vital interest in its environment and a long history of interest in Clear Lake. Because Waseca is a year-around town, well diversified industrially, the project will benefit all residents in that they will not have to travel elsewhere for their outdoor recreation. The project itself has allowed the hiring of a master's educated city limnologist and a person with the Young Adult Conservation Corps who conduct studies of the lake and of its recreational use. Neither of these individuals would have been hired without the project. In addition, businesses, such as motels, were reported to be experiencing much higher occupancy as a result of the civic pride taken in the lake. Waseca is a residential town as well, consequently, lake improvement will undoubtedly be reflected in augmented property values for real estate. As a desirable place to live, work, and play, the town will derive primary and secondary benefits from the proposed project, although these benefits were not quantified.

Fish and Wildlife

Fowl botulism caused by toxins produced from decaying algae (*Microcystis* and *Lyngbya*) and vegetation is likely to be lessened by reducing nutrient input to the Lake.

Public Health

Diversion and biological filtration of stormwater and other best management practices will improve conditions for contact recreation and will reduce incidence of minor infectious problems such as swimmers itch.

Research and Development

The presence of a biologist in City government is likely to have a positive net economic benefit as the city enters environmental management. The effect of educating citizens through "Waseca Water Weekend," an interpretive scientific activity for the citizens, is likely to prove stimulatory to Waseca's overall environmental program.

SUMMARY OF BENEFITS

CLEAR LAKE

Recreation:	
New Benefits	$ 9,100
Benefits Protected	500*
Aesthetics:	
New Benefits	16,600
Benefits Protected	8,900*
Economic Development	+
Fish and Wildlife	+
Public Health	+
Research and Development	+
Total First Year Benefits	$ 35,100+
Total Discounted Benefits	$471,500
314 Grant Amount	$358,682

*Increases by this amount each year

Data Sources: Town of Waseca, Engineering & Limnology Departments
Minnesota Department of Natural Resources
Minnesota Pollution Control Agency

Date of Site Visit: January 10, 1980

LAKE COCHRANE

Lake Cochrane is one of 250 natural lakes in northeastern South Dakota and serves as a popular recreation area for South Dakota and Minnesota residents. It is located near the South Dakota-Minnesota border in Deuel County. It has a surface area of 366 acres. Nearby towns with their respective estimated population and distance from Lake Cochrane (in miles) include Astoria, SD (150 and 11), Canby, MN (3,000 and 10), Clear Lake, SD (1,157 and 11), Gary, SD (366 and 5), and Toronto, SD (216 and 12).[2]

The onset of noticeable eutrophication in 1971, which was caused by intermittent surface inflow heavily laden with sediment and nutrients, prompted state and local agencies to seek funding for lake restoration or preservation.* In 1975 the East Dakota Conservancy Sub-District submitted a lake restoration grant proposal to the Environmental Protection Agency, and a grant was awarded January 1, 1976. The project was one of eleven projects in six states initially funded under the program.

The project objective was to demonstrate a low cost procedure which would reduce the influx of sediments and nutrients into the lake by building sediment traps directly upstream from existing and newly constructed lake perimeter roads. The project was also to demonstrate applicability in similar conditions throughout the United States. Basically, it required the construction of 2,658 feet of gravel road which was needed to complete the lake's perimeter road system; the construction of three sediment traps which would reduce sediment influx from 66 percent of the lake's watershed; the development of a new boat access area; and the use of two of the three sediment trap basins as fish rearing ponds. Various phases of the two-year project were financed with about $10,000 from the Sub-District, $9,000 from the EPA grant, $3,000 from the South Dakota Department of Game, Fish, and Parks, and $3,000 from Norden Township.

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*Jerry Siegel, prime coordinator for the Lake Cochrane project from the East Dakota Conservancy Sub-District, feels preservation rather than restoration is the proper term to use for this project, because Lake Cochrane was of high quality compared to other northeastern South Dakota Lakes when the project began. Therefore, the idea was really to maintain quality and prevent further eutrophication.

Since the project ended in 1977, very limited follow-up studies have been done to evaluate the project's net impact on water quality. Concurrent activities, such as the construction of lakeside housing, the development of the north end of the lake into a state park, and a four year area drought which ended in 1977, partly masked those benefits attributed to the sediment traps.[2,3,10] However, benefits are projected in seven areas - recreation, aesthetics, fish and wildlife, property value, education, and pollutant reduction.

Recreation[2,3]

Types of warm season recreation include picnicking, swimming, fishing, sailing and other small boating, hiking, and camping. On an average summer weekend, 70 percent of the lakeside cottages will be occupied and on a heavy day up to 200 people can be expected to enjoy the lake for its various uses. With the exception of camping in the park (which is proposed to receive state park status and will be described below) no user fees are collected. For a camp lot rental space and electrical hook-up $2.00 per night is charged. Fifteen electrical outlets are presently available and plans have been made to double these units within the next couple of years. The park is open Memorial Day through Labor Day. Due to severe weather in later fall through early spring, recreation is mainly limited to ice fishing and some snowmobiling and cross-country skiing during this time.

A year round estimate of the number of people using the lake per day is 75. Using a unit day value of $1.86 (10/3/6/10/8 = 37) per person,

$$75 \times 365 \times \$1.85 = \$50,917.50.$$

Because the objective of the project is primarily preservation, and the lake is in relatively good condition, it is assumed that 2 percent of this benefit, or $1,018, would be lost each year in the absence of the project.

Aesthetics

The aesthetic quality of the lake is also being preserved. Benefits are incorporated in the recreation estimate.

Fish and Wildlife

As originally planned, the sediment trap basins did provide excellent conditions for rearing walleye and northern pike fry in two separate years.[10] One year's accounting of stocking benefits looks quite good. About 180,000 fry were stocked in both ponds combined at a cost of $540 (at $3.00/1,000 fry).[3] At a 10 percent survival rate, 18,000 fingerlings (at $.20/fingerling) were subsequently released into Lake Cochrane.[3] The net benefit, excluding minor maintenance and supervision costs was:

$$\$.20\ (18{,}000) - \$540 = \$3{,}060.$$

Property Value Benefits[2,3]

In 1975 when the East Dakota Conservancy Sub-District submitted the restoration grant proposal to EPA, approximately 75 percent of the shoreline had been developed and 150 dwellings existed around the lake. Five percent of the homes were permanent, 12 percent summer, and 83 percent summer or weekend cabins. Nearly all of the shoreline has been developed since then with about 14 percent increase in the number of homes. There are currently only 6 permanent homes. It is not possible to attribute monetary benefit to any changes in property value which might have resulted from the restoration project.

Education, Research and Development[2]

The Lake Cochrane project has served as a technical and organizational demonstration project. Restoration work being done in Lake Herman (75 miles southwest of Lake Cochrane) is incorporating similar sediment trap/lake perimeter road designs. Success at Lake Cochrane, in terms of funding allocation through multi-agency coordination, has sparked the Oakwood Lakes and Lake Kampeska projects (35 miles southwest and 45 miles west of Lake Cochrane, respectively).

SUMMARY OF BENEFITS

LAKE COCHRANE

Recreation Protected	$ 1,000*
Aesthetics	+
Fish and Wildlife	3,000
Property Value	+
Education, Research and Development	+
Total First Year	$ 4,000+
Total Discounted Benefits	$52,500
314 Grant Amount	$9,906

*Increases by this amount each year.

Data Sources:

1. EPA Region VIII
2. East Dakota Conservancy Sub-District
3. South Dakota Department of Game, Fish, and Parks
4. South Dakota Department of Environmental Protection
5. U.S.D.A. Soil Conservation Service
6. South Dakota Department of Natural Resources Development
7. Deuel County Commissioners
8. Norden Township
9. First Planning and Development District, Watertown, SD
10. University of South Dakota (Dr. Lois Haertel)

COLLINS PARK LAKE

Collins Park Lake is located in the town of Glenville and the Village of Scotia, Inc., Schenectady County, New York. The Village of Scotia is located directly across the Mohawk River from Schenectady which is the source of most of the lake's users. Collins Park is located adjacent to the Mohawk River and is immediately visible to visitors entering town from the Schenectady area. The park and lake have always been the major drawing card for visitors to the Village of Scotia. The population of Scotia is 7,500, while the population of Glenville is 28,954 and the population of the area within a five-mile radius of the lake is 160,000.[2] The lake users are 32 percent from the Village of Scotia, 58 percent from the Schenectady area and 10 percent from other areas.[3] The lake covers about 54 acres.

Before restoration, Collins Park Lake had been plagued by sediment and nutrient loadings from storm sewer outfalls and surface runoff which resulted in rapid sediment buildup, increased turbidity and excessive growth of aquatic vegetation. The lake restoration project included reducing nutrient input through the elimination of both lakeside dumping of organic material and elimination use of fertilizer on adjacent lawns, improving maintenance of a flapper valve at the lake outlet to keep Mohawk River flood waters out, and dredging out about 100,000 m^3 of sediment.[3] Sediment was pumped to a nearby 6-acre spoils area which was enclosed by dikes. A 1,000 m^3 area around the lake outlet and storm sewer end of the lake was dredged to a depth of about 3 meters.[2] This area was left vegetated and is to serve as a nutrient and sediment trap for inputs from both the sewer and the outlet flapper valve. The area will serve to trap and eventually flush out nutrient and sediment inputs. Dredging of the lake proper took place during the summers of 1977 and 1978. The fine grained sand in the bathing area was replaced with coarser sand to help alleviate the turbidity problem.

Benefits from the improvement consisted of:

- Improved recreation potential, with swimming and skating made safe, boating less hindered by weeds and fishing expected to improve
- Education benefits, with Union College involved in the project

- Increased community pride and interest in the park
- Potential use of spoils and sediments for municipal projects.

Intangible aesthetic benefits included a decreased odor problem and the vegetation of an unsightly dump area with dredge spoils.

Recreation Benefits

Recreation uses of the lake after the project are the same as those before the project, although of improved quality due to weed control and decreased turbidity. Activities, with use and season estimates when available, are:

Activities	Use	Season
Swimming	800-900 bather/day (weekend)	Summer[4]
Fishing	939 trips (1977)	April-Oct.[5]
Skating	-	2 months[3]
Boating	3-8 boats/day	-
Picnicking	-	-

The swimming usage can be converted to a seasonal total by means of the Water Resources Council method described in Appendix C, page C-4:

$$50 \times 850 = 42{,}500 \text{ use days}$$

Fishing is already expressed as an annual total. Boating can be converted to annual usage by assuming a 100 day boating season, similar to that for swimming. An average of 5.5 boats per day for 100 days yields 550 boating use days.

The project is estimated to have increased the UDV for general recreation from \$2.15 (10/3/10/16/7 = 46) to \$2.32 (10/3/10/16/12 = 51). The corresponding increase in general fishing UDV is from \$2.42 to \$2.53. Recreation benefits are thus

$$\$.17 \times (42{,}500 + 550) + \$.11 \times 939 = \$7{,}422$$

Aesthetics

The increase in recreational benefit is, to a great extent, the result of improvements in aesthetic quality of the lake. Aesthetic benefits are thus incorporated in the recreation total.

Education Benefits

One hundred students at nearby Union College were involved in the project, including technical and tutorial work.[3] The improvement served as an educational tool as:

- 40 theses were written on the lake
- A seminar, field trips and public presentations were given
- An extensive computer program for monitoring was developed
- Continuing student interest was fostered.

SUMMARY OF BENEFITS

COLLINS PARK LAKE	
Recreation	$ 7,400
Aesthetics	+
Education	+
Total First Year	$ 7,400+
Total Discounted Benefits	$51,700
314 Grant Amount	$79,355

*Increases by this amount each year.

Data Sources:

1. New York Department of Environmental Conservation
2. Mr. Cal Welch, former Scotia Chairman of Park Commission and Project Coordinator
3. Dr. Carl George, Biology Department, Union College
4. State of New York, Amsterdam District Health Office
5. NYDEC Urvan Fisheries Program

ELLIS LAKE

Ellis Lake, actually three interconnected lakes* with a combined surface area of 37.5 acres, is located in the City of Marysville, Yuba County, California. Its setting is urban; it is within the Marysville business district, and most of its shoreline has been developed as city park. The lake and park are important aesthetic and recreational resources not only for the 9,600 citizens of Marysville but also for nearby Yuba City (population 18,400) and, to a lesser extent, for others among the 100,000 residents of Yuba and Sutter Counties.[1] Prior to the development of the various problems which prompted the city to seek a Clean Lakes grant, swimming, boating, fishing, picnicking, and aesthetic enjoyment were popular uses.[2]

Marysville is located in the rice-growing area of California's Central Valley, at the confluence of the Yuba and Feather Rivers. The city is protected on all sides by levees and, from the air, appears an island during serious floods. The river water is used for irrigation by rice-growers and other types of agriculture.

The primary objective of the Ellis Lake project was the erradication of Hydrilla verticillata, a rooted aquatic plant which had so infested Ellis and North Ellis Lakes that most forms of recreation had become virtually impossible. Classified as a noxious weed by the California Department of Agriculture, Hydrilla posed a serious threat to the $256 million per year rice industry as well as to navigation in California waterways. Related objectives were general improvement of water quality and appearance through reduction of pollutant and debris loadings.

Ellis and North Ellis Lakes were drawn down and approximately 2 to 3 feet of sediment were removed and landfilled. The lake bottom was treated with herbicides prior to refilling. Special weirs were designed for storm sewer outfalls which formerly carried virtually all of Marysville's stormwater into the lakes; now in operation, the weirs divert the first 15 minutes of major storms and the total flow of smaller events, and also collect debris and sediment. The diverted stormwater flows by gravity through the levee, where the outfall is protected by a tide gate. Stormwater had previously been pumped out of the city. A settling basin for this discharge is currently under design. A vacuum truck was purchased to clean storm sewer catch basins, and a number of other stormwater quality management practices were instituted. Finally, the cobblestone rip-rap at the lake margin had to be refurbished and lakeside walks repaired after the dredging equipment was removed; both were improved in the process. A well to replace the Feather River as a source of supplemental water for the lake is to be constructed.

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*Ellis Lake, North Ellis Lake, and East Lake.

Abatement of sanitary sewage discharges had not been a part of the project scope, since no such discharges to the lake were suspected. However, three illegal discharges were discovered during the storm sewer work, and their owners have since complied with orders to connect to the muncipal sewer system.[2] This action, coupled with the stormwater diversion and best management practices, is expected to make possible the restoration of contact recreation in the lakes.[1] Swimming had been prohibited by city ordinance since 1969.[4]

With the lake only recently (December 1979) refilled, the extent to which desired benefits will be realized is not known with certainty. However, fairly firm projections can be made. Benefits are projected in the categories of recreation, aesthetics, flood control, economic development, fish and wildlife, agriculture, public health, research and development, pollutant reduction and reduced lake management costs. These are discussed briefly below and summarized in the table at the end of this section.

Recreation

Removal of Hydrilla, improvement in water quality, and recent fish stocking make possible restoration of recreation from essentially zero to 75,000 use-days per year, valued by the grantee (using Water Resources Council UDV method) at $1.92 per use-day, for an annual benefit of $144,000. All pre-project uses, plus contact recreation, will be possible.[5]

Aesthetic Enjoyment

Because of its setting, Ellis Lake is the most significant feature of Marysville and is probably seen daily by every resident. The grantee calculated 16,900 passersby each day, 365 days a year, with a value per use-day of \$.73.[5] This appears to overstate the benefit in monetary terms, although it is an important aspect of the quality of life in Marysville. A more conservative calculation would be 16,900 ÷ 2 passersby (assuming a round-trip as one use-day) multiplied by 240 days (assuming weekend use is included under recreational benefit) at a value of \$.18 (UDV method to show improvement in aesthetic quality), for a total benefit of \$365,000 per year.

Flood Control

Storm drainage modifications have reduced the incidence of nuisance street flooding to nearly zero. Substitution of gravity flow for pumping at the levees except during flood conditions will save \$1,800 in pump operation and maintenance costs annually, by the grantee's estimate.[2]

Economic Development

Developable land within the levees is limited, and housing is in short supply. Disposal of dredge spoil in a low, undevelopable area has added 15 acres of developable land. Conservatively this could permit construction of 50 residential units, average value \$70,000. At an effective tax rate of 1%, this can be valued at \$35,000 per year in new city revenues, plus capital gains and secondary benefits which could not be quantified.[1]

Fish and Wildlife

Prior to drawdown, game and panfish and ducks were removed from the lakes. Now that they are refilled, stocking with bass, catfish, and sunfish has been accomplished and ducks are being captured elsewhere and returned to the lake.[2]

Agriculture

Losses to rice-growers if Hydrilla escaped from strategically-located Ellis Lake are conservatively estimated at $1,000,000 annually. Since the weed has been known to be in the lakes since 1976 and has so far apparently been successfully prevented from escaping into the rice fields, it seems legitimate to include this cost-savings as a project benefit.[4]

Public Health

Elimination of illegal sewer connections, diversion of stormwater, and best management practices have improved water quality to the point that contact recreation will no longer be precluded by unsanitary conditions.[2] The ordinance prohibiting such activities is expected to be rescinded in 1980.[1]

Research and Development

Prior to discovery of Hydrilla in Ellis Lake, its presence had not been suspected in California. The Ellis Lake experience prompted further investigations, and the plant has since been found in the Imperial Valley and in ponds near Santa Barbara.[2] Aggressive control measures now underway may save California from expenditures similar to Florida's $10-$12 million annual budget for partial control of Hydrilla in its waterways.[4]

Reduced Lake Management Costs

Marysville had been spending $50,000 annually for weed control, debris removal, etc. Current estimates are for a budget of only $3,000, a $47,000 benefit in cost savings.[2,5]

SUMMARY OF BENEFITS

ELLIS LAKE

Recreation	$ 144,000
Aesthetics	365,000
Flood Control	1,800
Economic Development (Housing)	35,000
Fish and Wildlife	+
Agriculture	1,000,000
Public Health - Abatement of Unsanitary Conditions	+
Research and Development - Early Warning of *Hydrilla*	+
Lake Management Cost Savings	47,000
Total First Year	$ 1,592,800+
Total Discounted Benefits	$11,123,000
314 Grant Amount	$ 1,625,000

Data Sources:

1. City of Marysville, City Administrator
2. City of Marysville, Department of Public Works
3. U.S. EPA Region IX
4. 314 Grant Application
5. Supplement to 314 Grant Application, Appendix A

Date of Site Visit: January 9, 1980

59TH STREET POND

The four acre man-made lake is located at the southwest corner of Central Park, New York City, New York, at one of the major park entrances (see attached map). There are eight other distinct bodies of water in this park of approximately 750 acres. A population of 231,650 lives within the immediate vicinity of the park, which also attracts a large number of tourists.

The pond's condition before the project was initiated reflected a major problem common to all areas of Central Park: erosion. The pond was heavily silted, as well as eutrophic. The pond margin was also somewhat unsafe, due to the poor conditions of the riprap and the sidewalk.

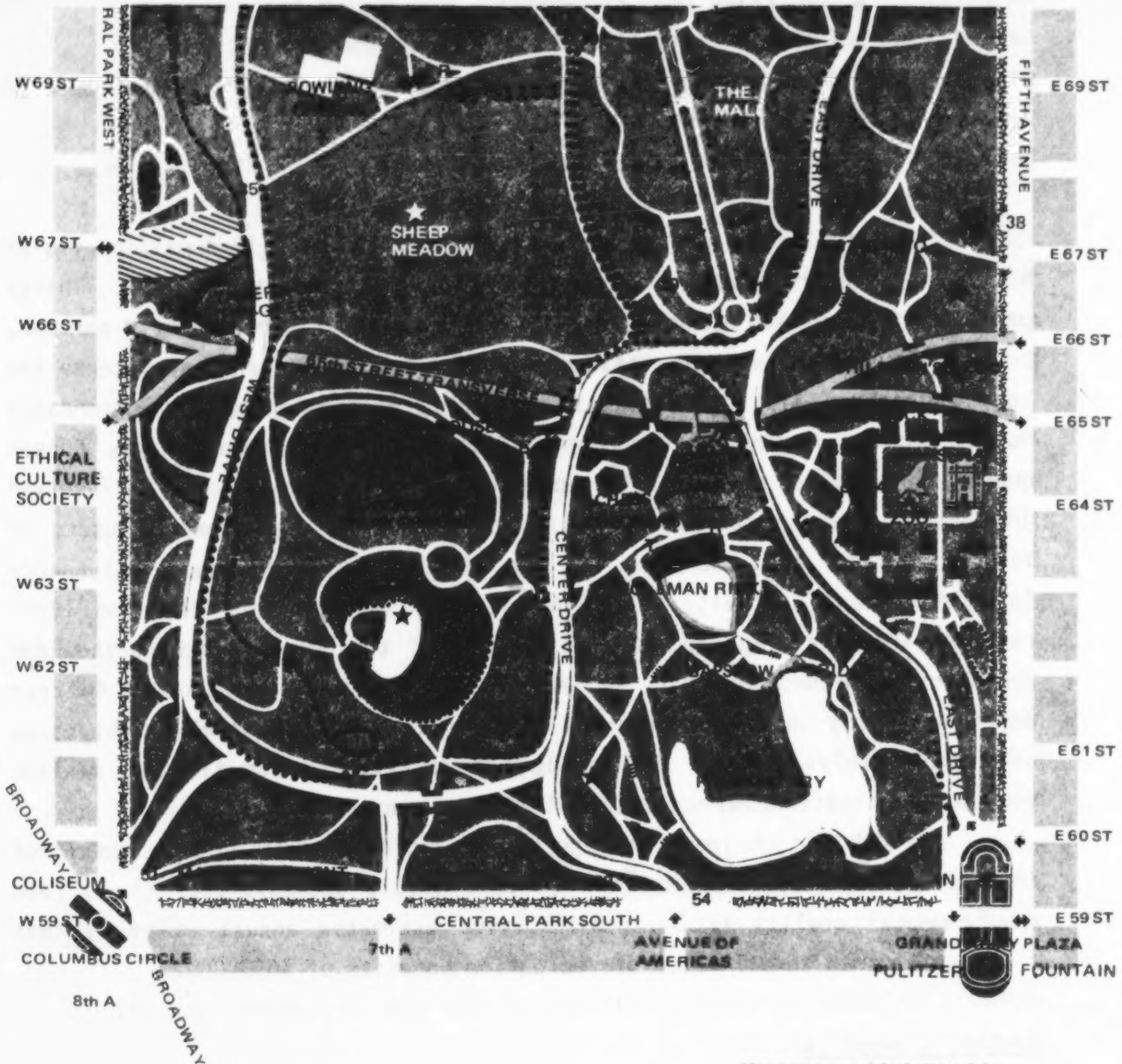
The project, undertaken to restore and preserve the lake's ornamental value as an integral feature of Central Park, is expected to be completed in spring 1980. It entails lake draining and dredging, with the bottom of the lake to be made impermeable to prevent entrance of remaining bottom nutrients into the water column. In addition, the bank riprap is being repaired and clogged stormwater drainage pipes are being cleaned.[5]

A complementary $2 million landscaping project is currently underway in the immediate park vicinity (area bounded by Center and East Drives). The landscaping project, expected to be completed in 1981, is directed towards the green and skating rink areas.[6]

Direct benefits from the improvement are expected to fall into three categories: recreation, flood control, and public health. There are also aesthetic benefits which may affect park attendance and, through visual amenity, nearby hotels and the park's historic value. There are no significant economic or property value benefits associated with lake improvement, primarily because area hotels and restaurants are well-established and property values in the vicinity are already so high.[6]

Recreation Benefits

Pre-improvement recreation uses of the pond area were primarily passive, including substantial lunchtime use by individuals employed in the area. No changes in pond use are expected after the improvement, with the exception that there may be limited boating.


RAL PARK WEST
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ETHICAL
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BROADWAY
COLISEUM
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CENTRAL PARK SOUTH
7th A
AVENUE OF
AMERICAS
GRAND ARMY PLAZA
PULITZER
FOUNTAIN

Map based on original research by Christina Balas & Garry Kandler for Pratt Institute, The NYJL & The CPCF, design by Oliver-Beckman, Inc.

It is important to note that the pond is not the only recreational feature in this part of Central Park. Also available are:

- Birdwatching near Promontory
- Ice skating at Wollman Rink
- Roller skating, with concession located in the Mineral Springs Building approximately 10 blocks away
- Picnicking on nearby tables.[1]

According to the most recent estimates[2] there were 12.8 million visits to the park (approximately 3.3 million different visitors) in 1973. Thirty percent or 3.8 milion spent their time south of 66th Street. Forty percent, according to a sample, cite this area as their favorite, in part because the zoo is nearby. Also, according to a sample, 60 percent of park attendance is for passive recreational purposes, such as walking and reading. Consequently, of the 3.8 million in the pond vicinity, 2.3 million may be involved in passive recreation. This total must be reduced by numbers of users of facilities other than the pond. At the adjacent ice rink, annual attendance for the seasonal activity was 94.6 and 96.8 thousand for 1978 and 1979, respectively.[3] Average summer daily usages of the zoo, children's zoo, and Hecksher Playground are 300, 55, and 108, respectively, totalling 463 per day.[2] Assuming this rate prevails throughout 6 months, total annual usage is approximately 83,300. Subtracting these results from the 2.3 million yields an estimated pond usage of 2.1 million user-days per year.

The UDV for the pond is expected to increase by $0.33 as a result of improvements in capacity (safety) (+ 10 points), accessibility (+ 3), and environmental quality (+ 5). Multiplying estimated annual usage by this amount yields an annual value of recreation benefits of $693,000.

Aesthetic Benefits

The pond improvement is expected to have four impacts on aesthetic amenity. The estimate of the resultant benefit is incorporated in the recreation estimate.

- Odor problem: A reported odor problem is expected to be eliminated by the improvement.
- Park access: The pond serves primarily an ornamental value at one of the park's most extensively used entrances. According to the Savas study, approximately 30 percent of all visits to the park were made through park entrances between 59th and 66th Streets.
- Visual amenity to nearby hotels: The visual quality of the pond is an amenity to neighboring hotels. However, while a significant deterioration would have marginally impacted hotels, since a view of Central Park and the pond act as a drawing card for tourists, improvement is not expected to substantially improve hotel business. Neighboring restaurants are too well-established to be impacted by pond's visual quality.
- Historic value: Because the pond is integral to Central Park as a whole and contains a number of historic points of interest, pond improvement will serve to maintain the historic character of Central Park.

Flood Control

The pond improvement is expected to reduce a flooding problem which became severe during heavy rain. Pond silting created a back-up on 65th Street Transverse Road, which was sometimes closed by police in heavy rain periods.[1]

Public Health

The improvement is expected to diminish a reported mosquito problem.

SUMMARY OF BENEFITS

59TH STREET POND

Recreation	$ 693,000
Aesthetics	+
Flood Control	+
Public Health	+
Total First Year	$ 693,000+
Total Discounted Benefit	$4,837,000
314 Grant Amount	$ 498,035

Data Sources:

1. Central Park Community Fund
2. A Study of Central Park by E. S. Savas (December 1976)
3. Study of Wollman Rink, for Central Park Community Fund (May 1979)
4. Environmental Protection Agency Clean Lakes Office
5. EPA Region II Clean Lakes Coordinator.
6. City of New York, Department of Parks and Recreation, including Department of Parks Maintenance

Date of Site Visit: December 20, 1979

FRANK HOLTEN LAKES

Lakes #1, 2, 3 of Frank Holten State Park, East St. Louis, St. Clair County, Illinois are waterfilled remnants of a single abandoned meander scroll of the Mississippi River. Together the lakes comprise approximately 65 acres broken down as #1, 53 acres; #2, 4 acres; #3, 8 acres. They are relatively shallow, averaging some 5' in depth for Lake #1, 16' in depth for Lake #2, and 6' in depth for lake #3. The lakes are surrounded by a 1,125 acre park which also occupies the "flood plain" of the meander scroll. Topography of the park is level and the water table rises to within a few feet of the soil surface which consists of sediments with poor internal drainage. Because the lakes are remnants of a meander of relatively recent age, a natural tributary system to the lakes has not developed. Lakes #1 and #2 are interconnected, and Harding Ditch, a man-made feature draining urban land, flows into Lake #3. Preliminary fisheries investigations dating to 1959 revealed that turbidity was a major factor accounting for the presence of large numbers of rough fish, but strong populations of largemouth bass, white crappie, carp and buffalo fish were also present. Decline in fish populations occurred over the next 12 years until sampling was terminated in 1971 due to the "unmanageable nature of the lakes in their present condition."

In 1976, funds were requested for lake improvements. Planned actions include dredging of the three lakes, construction of an inverted siphon under Harding Ditch to connect Lake #2 with Lake #3, removal of accumulated silt and nutrients from Holten Lakes by dredging, relocation of Harding Ditch around Lake #3 and isolating the ditch from the lakes by construction of an inverted siphon. Isolation of the lakes from Harding Ditch reportedly will eliminate the primary source of silt and nutrients and prevent infestation of the lakes with undesirable fish species. The project will further enhance current uses of Frank Holten State Park by restoring depth to the lakes, allowing improved fisheries management and, consequently, improving healthful recreation opportunities for the public.

Principal project benefits are in the areas of recreation, aesthetics, economic development, public health, research and development, pollutant reduction, and improved lake management.

Recreation

Prior to the program there was some fishing in the park. Camping in the park has been discontinued for various sanitary and social reasons. Ice comes into the lakes in December and goes out in March leaving approximately 245 days of ice-free water. Park use, however, constitutes 12 months of activity and the park is an active center for recreational opportunities.

Creel census for 1967 determined 159,000 days of recreational use of the lakes for fishing. At an average value of \$2.51 per use day (17/3/8/11/11 = 50), a total value of \$399,090 existed. As a result of the project, fishing use could increase by 50,000 days/year and increase in value to \$2.96/use day (25/3/12/14/18 = 72). The recreational benefit is:

$$(\$2.93 - 2.51) \times 159{,}000 + (\$2.96 \times 50{,}000) = \$214{,}780$$

Aesthetics

Because of its setting, Frank Holten Lakes are principal features of the park. No usage records for recreational use other than fishing exist. (These uses include picnicking, boating, nature study, golf and baseball.) However, an estimate can be derived from national statistics on outdoor recreation participation, which indicate that for every 3.3 user-days of fishing by a person over the age of 9, participation in boating, birdwatching, playing outdoor games and sports, nature walks, and picnicking totals 26.4 user-days.* This suggests that

$$\frac{209{,}000}{3.3} \times 26.4 = 1{,}672{,}000$$

user-days of other recreation are associated with the 209,000 project user-days of fishing. Not all of this would necessarily take place within the park, but it is safe to assume that the usage for general recreation is at least twice that for fishing, or 400,000 user-days. As a result of the lake improvements, the increase in UDV from aesthetics (7 points in environmental quality) is $.13 and the new aesthetic benefit is therefore $52,000 annually.

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*U.S. Department of Interior, Bureau of Outdoor Recreation, "The 1970 Survey of Outdoor Recreation Activities Preliminary Report". 1972.

Economic Development

The lakes are in a neighborhood in which most residents are minorities. The restoration program appears to be creating more than the usual number of construction and related managerial jobs. The park itself employs 8 people, at present, and expansion of the facilities will ensure both their own as well as other jobs.

Overall improvement of the lakes will undoubtedly elevate property values in Centreville, E. St. Louis, and Alorton which border on the park. There is some developable land in the vicinity, and it is also likely to escalate in value.

Public Health

Diversion of stormwater and other best management practices will ensure healthful activities within the park. Any chemical residues will be proportionately reduced.

Research and Development

It is likely that the experience of rejuvenating and managing this urban lake will provide knowledge and skills applicable to other similar projects and, consequently, be of R and D value.

It is entirely possible that a now defunct nature interpretive program will be reinstituted after the program is completed, since this is a major urban park.

Reduced Lake Management Costs

The project will eliminate the necessity for dredging within a planning horizon of 25 years. But management costs, particularly periodic monitoring and restocking of fish will increase. Consequently, it is thought that there will be a small but unmeasurable net benefit.

SUMMARY OF BENEFITS

FRANK HOLTEN LAKES

Recreation	$ 214,800
Aesthetics	52,000
Economic Development (All General)	+
Public Health	+
Research & Development	+
Lake Management Cost Savings	+
Total First Year	$ 266,800+
Total Discounted Benefits	$1,862,300
314 Grant Amount	$ 927,000

Data Sources:

1. Illinois EPA, Water Pollution Control
2. Illinois Dept. of Conservation
3. Frank Holten State Park

Date of Site Visit: January 14, 1980

LAKE HENRY

Lake Henry is located on the edge of the town of Blair, Wisconsin. The lake has a surface area of 43 acres and is situated in Trempeleau County. The population of Blair is 1,036 while the combined population of Trempeleau and the contiguous counties is 289,600. The general area consists of farmland.

Approximately one third of the lake perimeter consists of a town park with camping, sports, picnicking facilities, and one boat launch. The lake is the primary recreational water body in the area. At its peak, Lake Henry was used for swimming, boating, fishing, water skiing, ice fishing, and hydroplaning. However, in recent years use had been almost entirely restricted to ice fishing.

Soil from the 116,000 acre watershed had settled in Lake Henry and had curtailed or limited the recreational use of the lake. The lake had become so shallow that in the winter the water froze to the bottom except for a small channel. The purpose of the restoration project was to deepen Lake Henry and to take certain measures for preventing soil losses in the watershed. Two miles of riprap was placed along upstream banks along with one-half mile of fencing to prevent cattle from access to the stream. A diversion system was also installed to divert feedlot nutrient-laden runoff. The dredged amount was 220,000 yd^3 which was placed in three spoils sites. The dredging is estimated to have increased Lake Henry's life by 70 years. The project was completed in late summer, 1979.

The benefits achieved by the restoration project include increased recreation, reduced soil erosion, education, fill material, reduced maintenance costs, and community spirit.

Recreation and Aesthetics

The project has restored boating, fishing, and swimming as recreation uses. Water skiing will become possible if a variance from the Wisconsin no-wake law for lakes under 100 acres is obtained. To-date, there has been a yearly increase of 351 user days for non-fishing boating and a projected additional increase of 234 user days for a total of 585 user days per year which, at a UDV of $1.93, are valued at $1,130 (13/2/7/8/10 = 30).[1]

Since dredging, the lake was stocked with 6,000 largemouth bass fingerlings, the first such stocking in many years.[3] In addition, the town is applying to DNR for a variance to the no-wake law in Wisconsin for lakes less than 100 acres. If granted the City will install another boat launch.[1]

Fishing user days have already increased by an estimated 619 per year and are projected to increase by another 619 days.[1] The annual benefit of increased fishing user-days is 1,238 times $2.28 (40 points), or $2,820.

Education

A local high school teacher was responsible for sample collection and some testing during the restoration project. During the project he taught students how to perform this work, and he has since created an ecology course in his school. The lake is used for a lab. This is a non-quantifiable benefit.

Fill Material

The dredged sand is of a quality that can be sold at $.10/yd^3 according to a local sand and gravel supplier. The price is also what Blair now pays for purchased sand as cover for their landfill.[1] The value is $22,000. The value of the land taken out of use as a spoil area (26 acres x $500/acre = $13,000) has not been deducted because it can be returned to other uses as the spoil is removed.

Reduced Lake Maintenance Costs

The soil loss prevented by implementation of watershed management practices is estimated at 4,150 tons per year.[6] If 50 percent of that amount would have eventually settled in the lake in the absence of the project, the 220,000 cubic yards dredged from the lake would have been replaced in 18 years (assuming 6 cubic yards per ton). Because the lake's useful life is estimated to be 70 years after the project, the benefits of soil loss prevention can be estimated as the difference between the present value of repeating the dredging, at a cost of $285,000, in 18 years and in 70 years, or $80,300.

Community Spirit

The people of Blair are very proud of the Lake Henry restoration project. The town held a lake restoration dedication ceremony, and two project workers (the manager and the SCS representative) were recipients of Wisconsin DNR awards. All local project funding votes were unanimous, and the local and regional papers have carried stories commending the citizens of Blair for their pilot lake rehabilitation project.

SUMMARY OF BENEFITS

LAKE HENRY	
Recreation and Aesthetics	$ 4,000
Agriculture	+
Education	+
Reduced Maintenance Costs	80,300*
Community Spirit	+
Value of Dredge Spoil	$ 22,000*
Total First Year	$106,300+
Total Discounted Benefits	$134,200
314 Grant Amount	$220,000

*One-time benefit assigned to first year only.

Data Sources:

1. Lake Management District of Blair
2. Wisconsin Department of Natural Resources
3. Wisconsin Fisheries Management
4. Trempeleau Agricultural Agent
5. Soil Conservation Service
6. Soil and Water Conservation District
7. Local Realtors

Date of Site Visit: December 17-19, 1979

LAKE JACKSON

Lake Jackson, located 6 miles north of Tallahassee, Florida, has a surface area of 4,000 acres. With approximately 100 private homes in its vicinity, the lake serves a Tallahassee population of 140,600 and a greater metropolitan area population of 390,980. The region's population is growing rapidly, accompanied by increased demand for [illegible]ng.

Lake Jackson has been adversely affected [illegible] runoff from construction and residential development. The project, intended to reduce sediment and nutrient inputs from Megginnis Arm Watershed, is still in the early stages, with no construction underway at this time. It involves construction of marsh detention ponds. Property acquisition took place in fall, 1979, with property acquired costing $13,000 to $20,000 per acre. Primary benefits expected from the improvement are:

- Protection of the lake's important bass fishing activity
- Preservation of recreational activities and property values.

The types of recreation uses of the lake, which are typically year round, are not expected to change after the improvement. They consist of fishing (for which the lake is nationally known), water skiing, boating, some swimming and bird hunting. The project is expected to preserve and improve the quality of uses, rather than increase the number of users.

Recreation

The most important recreation use of the lake is bass fishing, which, in July 1979, was the subject of Field and Stream's cover story. The monetary value of the lake's fish population has been estimated in a report by the Florida Department of Administration, Bureau of Land and Water Management at $11.4 million. A 2.46 benefit:cost ratio has been estimated for the project's contribution to fishing returns.* Fishing benefits are estimated on the basis of the assumption that deterioration in water quality would reduce the fish population's value by 2 percent annually, or $228,000. Other recreational benefits are estimated under Aesthetics, since it is aesthetic conditions which most directly affect participants in activities other than bass fishing.

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*Water quality contributes directly to the quality of fishing, as sediment blankets the sandy bottom used by bass to spawn their young.

Aesthetics

Besides water-related recreation, the lake area is used for relatively passive activities. These include hiking and picnicking in Indian Mounds State Park, which overlooks the affected arm of Lake Jackson. The lake's water quality affects park use through its impact on aesthetics, as the park is roughly 20-50 yards from the water. Usage estimates for the 66 acre park are:[1]

Year	Florida	Other
1977	17,852	642
1978	16,783	670
1979	19,553	590

Averaging these values yields a mean annual park usage of 18,700. At a UDV for general reaction (since fishing use is evaluated separately) of $2.71 (16/6/11/14/15 = 62), annual recreational benefit to park users is:

$$18,700 \times 2.71 = \$50,677$$

In addition, the occupants of approximately 100 dwellings near the lake derive similar benefits. Since this is not a vacation community but one which houses year round residents, one can assume that residential usage of the lake, even if just for aesthetic enjoyment, is at the rate of one user-day per resident, rather than at a more intensive rate of two or three. Consequently, assuming 35 members per household, annual aesthetic benefits to residents are:

$$100 \times 3.5 \times 365 \times \$2.71 = \$346,200$$

Total annual aesthetic benefits are therefore $396,800. If 2 percent of this amount would also be lost each year in the absence of this project, the annual increment of benfeits protected would be $7,900.

Property Value

The water quality of Lake Jackson has undoubtedly had a direct impact on lakefront property values. Owners have complained about degradation due to sediment and debris. However, there were not sufficient data to permit estimation of benefits using the property value technique.

SUMMARY OF BENEFITS

LAKE JACKSON

Recreation (fishing)	$ 228,000*
Aesthetics (other recreational uses)	7,900*
Property Value	+
Total First Year	$ 235,900+
Total Discounted Benefit:	$7,309,800
314 Grant Amount:	$ 725,663

*Increases by this amount each year.

Data Sources:

1. Florida Department of Environmental Regulation
2. Northwest Florida Water Management District
3. Florida Game and Fresh Water Fish Commission

Date of Site Visit: January 7 and 8, 1980

LAKE LANSING

Lake Lansing, a 450-acre lake in Ingham County, Michigan, had been described as "the only major surface water resource for recreation in the Lansing metropolitan region.[1] (There is another large lake, 300-acre Lake Geneva, but its shoreline is entirely in private ownership.[3]) Approximately 350,000 people live in its vicinity.[2] The lake has historically been used for sailing, swimming, and fishing, but its usefulness has been limited by shallowness (5 to 6 feet over much of its area), aquatic weed growth, and the general perception by the public that it is "dirty". While property values in much of Meridian Township have been appreciating rapidly, lakefront properties have not kept pace and in some cases have actually deteriorated.[3] This is a good indication that obvious nuisance conditions exist there.

The watershed was sewered in the 1960's, with a noticeable improvement in water quality.[3] It is described as "stabilized in terms of erosion".[1] The objective of the lake restoration project is to improve and expand lake uses through dredging to a depth of 12 feet. Dredging is currently in progress.

Benefits are expected in recreation, aesthetics, economic development, property value, and research and development.

Recreation and Aesthetics

After project completion, the lake will be deeper, more attractive in appearance, and less weedy. Sailing and fishing are expected to improve, water skiing and power boating will become possible, and swimming should be more attractive.[2,4,5]

Most visitors to the two county parks on the lake use the beaches or the nearby picnic areas. Both facilities are currently being used at 100 percent of capacity on weekends and 70 to 80 percent on weekdays. Annual visitor days determined by car count in 1979 were 18,4000 for Lake Lansing South and 37,000 for Lake Lansing North. New park facilities are under development to expand capacity, but the size of the expected increase in usage is not known.[5]

There is no adequate public boating access on the lake at present, but a facility with parking space for 65 cars is about to be constructed. It is expected to be used to capacity at most times, thus adding a daily increment of 65 boaters, or 11,700 use-days over a six-month season.[5] A state survey has shown a steady increase in boating in Ingham County:

1971	10,000 use-days
1974	10,000 use-days
1977	23,500 use-days

More than half of these use-days are probably spent on Lake Lansing, since the only public body of water large enough to constitute a reasonable alternative is Grand River.[6]

State fishing surveys probably understate actual use; they are based on a sample of licensed fishermen, and persons under 17 years of age or spouses of license-holders are not required to be licensed themselves. Fishing use-days for Lake Lansing from the most recent years for which statistics are available are:

1975	32,130
1976	5,280
1977	20,447
1978	14,480

The variability of these records is probably the result of the small sample size (1 percent of licensed fishermen statewide) used in the survey.[7] Consequently, the mean for the last four years, 18,000, will be used in this analysis. Bluegill, northern pike, muskellunge, yellow perch and crappie are the commonly-taken secies.

The post-restoration UDV for general recreation at Lake Lansing is estimated at \$2.30 (9/8/9/14/10 = 50), an increase of \$.62 from a pre-project \$1.68 (5/8/5/10/2 = 30). Corresponding UDVs for general fishing are \$2.51, up \$.44 from \$2.07. These values can be used to estimate recreational benefits. For beach and park use, assuming 1979 usage levels continue, the benefit is

$.62 x 221,000 = $137,000

For existing boaters (1977 total), assuming conservatively that 50 percent of Ingham County boating takes place at Lake Lansing

$.62 x 0.5 x 23,500 = $7,300

New boaters expected to use the lake when access is provided will add an additional benefit of

$2.30 x 11,700 = $26,900

However, because an unknown part of that benefit must be assigned to the launching facility construction, we have chosen to include only half the amount, or $13,400, in the Clean Lakes project benefits. Benefits from improved fishing can be estimated at

$.44 x 18,000 = $7,900

Total annual recreation benefits are therefore an estimated $165,600.

Economic Development

The lake restoration project is expected to make living near the lake more attractive, leading to new residential construction and resulting secondary benefits. No specific value could be assigned.

Property Value

Meridian Township has observed a reversal of the declining trend in property values for houses bordering the lake. There were not sufficient data to permit assigning a numerical value to the increases, however.

Education, Research and Development

Education benefits from the project are expected to be substantial. Michigan State University began a five year study in April, 1978 to examine the impact of the dredging on the production of macrophytes, algae, invertebrates, and fish, and to evaluate the ecological impact of dredged materials on spoil sites. Data on the dredging will be used to develop a handbook for selecting future dredging methodologies.[1]

SUMMARY OF BENEFITS

LAKE LANSING

Recreation and Aesthetics	$ 165,600
Economic Development	+
Property Value	+
Education, Research and Development	-
Total First Year	$ 165,600
Total Discounted Benefit	$1,555,900
314 Grant Amount	$800,000

Data Sources:

1. McNabb, C. D., "Evaluation of Dredging as a Lake Restoration Technique, Lake Lansing, Michigan", Department of Fisheries and Wildlife, Michigan State University
2. Meridian Township Manager
3. Environmental Impact Assessment for FWPCA Grant Application 16010, Lake Lansing Lake Board of Ingham County, 1971
4. Ingham County Drain Commissioner
5. Ingham County Road Commission
6. Michigan Department of Natural Resources, Law Enforcement Division
7. Michigan Department of Natural Resources, Surveys and Statistics

Dates of Telephone Interviews: January 16, February 27, 1980

LIBERTY LAKE

Liberty Lake is a 713-acre body of water in the town of the same name, approximately 20 miles east of Spokane, Washington. The lake is situated in one of the more scenic locations in the Spokane area - in a basin formed in the foothills of mountains visible further to the east. The relief of the site varies from about 2,000 feet to 4,500 feet in elevation. Most of the watershed is relatively undisturbed forest. The lake is inhabited by a variety of waterfowl, including grebes, gulls and terns. Hiking trails and a marsh observation platform are maintained by Spokane County.

Direct uses of the lake include swimming, fishing, and boating. The site includes facilities for picnicking, camping, and golf. Prior to the project, many of these uses were being made less attractive by heavy summer blue-green algae blooms. The nutrient enrichment which caused the blooms was attributed to nutrient loadings from tributaries, septic tank seepage, urban runoff, and poor solid waste disposal.[1]

The 314 project's objectives were to reduce or eliminate nuisance blooms, to improve water clarity, to ameliorate problems asociated with decaying algae and aquatic plants, to meet Federal and state water quality standards, and to implement watershed management to perpetuate improved water quality. To date, sewer installation and modification of Liberty Creek's channel have been completed. Stormwater management, dredging, and alum treatment for phosphorus precipitation are scheduled for 1980. Benefits are expected to be achieved in two years, without the need for repeat alum treatments which would otherwise be required biannually to produce the same water quality results.[1]

Benefits are projected in six categories - recreation, aesthetics, property values, public health, education, and pollutant reduction.

Recreation

Fishing season runs from April through November; all other recreational activities are May through October. Pre-restoration recreational volume in use-days per year is tabluated below:[3,4]

o	Swimming	24,800
o	Picnicking	21,200
o	Fishing	13,000
o	Boating	15,200
o	Camping	11,200
o	Golf	18,000
	Total	103,400

Historical records show that fishing activity used to average 27,000 use-days; the volume declined because of poor water quality and associated adverse publicity.[1,3] Analogous statistics are not available for other forms of recreation, but it is reasonable to assume that swimming and boating were similarly affected.

When the project is completed, one can assume a return to at least the recreational volumes experienced before the deterioration of the lake. In other words, a gain of 14,000 use-days for fishing and a similar increase for swimming:

$$\frac{14{,}000}{13{,}000} \times 24{,}800 = 26{,}700$$

Total swimming use-days should thus increase to approximately 51,500. It is more difficult to project the likely boating increase, but, assuming it is one-half that for fishing:

$$0.5 \times \frac{14{,}000}{13{,}000} \times 15{,}200 = 8{,}200$$

Assuming no increase in other recreation activities (a conservative assumption), and using UDV's of $1.81 and $2.18 (10/3/7/8/7 = 35) for recreation and fishing, respectively, the new recreational benefit produced by the project is:

$$\begin{aligned} 26{,}700 \times 1.81 &= \$48{,}300 \\ 8{,}200 \times 1.81 &= 14{,}800 \\ 14{,}000 \times 2.18 &= \underline{30{,}500} \\ &\quad \underline{\underline{\$93{,}600}} \end{aligned}$$

In addition, existing levels of benefit are protected from further deterioration. If one assumes complete loss of benefit in 50 years, or a 2 percent annual loss, the incremental benefit from avoiding this loss each year is:

Fishing:	.02 x 13,000 x 2.18 =	$ 566.80
Boating:	.02 x 15,200 x 1.81 =	550.24
Swimming:	.02 x 24,800 x 1.81 =	897.76
		$2,014.80

Since a new increment of loss is prevented each year, the benefits increase by the same increment from one year to the next.

Aesthetics

Improvements in perceived water quality obviously are a major factor in the increase in recreational benefits. However, aesthetic improvement also benefits park users who do not use the lake directly. Assuming an improvement of 10 points (UDV method) or $.18 in aesthetic quality, this benefit can be estimated at:

$$50{,}400 \times \$.18 = \$9{,}100$$

Following the same reasoning as for recreation, there is also an aesthetic benefit being protected. Using the lowest UDV value as a conservative estimate, and assuming 2 percent annual loss in the absence of the project:

$$0.02 \times 50{,}400 \times \$1.07 = \$1{,}078$$

Property Values

A significant increase in property values is anticipated at Liberty Lake. In fact, this phenomenon is currently under study by researchers from Oregon State University. However, no quantitative results are yet available.[5]

Public Health

Among the nuisance algae in Liberty Lake were *Gloeotrichia echinulata*, believed to be a cause of "swimmer's itch", and *Anabaena flos-aquae* which can form toxic compounds in the process of decay.[1] These problems should be eliminated by the restoration project.

Education, Research and Development

Liberty Lake is under intensive study by limnologists, sociologists, and economists from Washington State University and Oregon State University under EPA grants, and the restoration project and post-restoration monitoring should produce valuable information for use elsewhere.

A citizens' advisory committee was formed to educate the public about the restoration program.

SUMMARY OF BENEFITS

LIBERTY LAKE

Recreation	
New Benefits	$ 93,600
Benefits Protected	2,000*
Aesthetics	
New Benefits	9,100
Benefits Protected	1,100*
Property Values	+
Public Health	+
Education, Research and Development	+
Total First Year	$ 89,900+
Total Discounted Benefits	$813,000
314 Grant Amount	$577,975

*Increases by this amount each year.

Data Sources:

1. Michael A. Kennedy Engineers
2. Town of Liberty Lake
3. Spokane County Parks Department
4. Washington Fish and Game Department
5. Liberty Lake Sewer District

Date of Visit: January 9, 1980

LILLY LAKE

Lilly Lake is situated in the southeast corner of Wisconsin, 20 miles west of Kenosha. The population in the immediate vicinity is 2,565 while the Kenosha County population is 125,000. Lilly Lake is 88 surface acres in size and prior to dredging had a mean depth of 4.7 feet with a maximum of 6.0 feet. The watershed is 384 acres.

The community is a lake resort which developed in response to the attractiveness of the area. Approximately 80 percent of the shoreline is occupied by private homes. The remaining shoreline has a public beach, which supports about 150 people, and a commercial beach which supports 125. Approximately 36 percent of the land nearby is cropland, 47 percent wetlands and woods, and the rest for residential, transportation and communication uses. Prior to the lake restoration project, water activities included limited boating and swimming, fishing, water skiing and ice skating. A boat launch is provided at a public park as is a small boat rental livery.

The water quality problems of Lilly Lake were silting, weeds, and other organic growths, fish kills and aesthetic unpleasantness. The silting caused 43 percent of the surface area to be unavailable for boating. The oxygen demand from decomposing sediment caused such a dissolved oxygen depletion, particularly in winter, that fish kills occurred frequently. Weeds were inhibiting swimming as well as boating and were presenting an unaesthetic appearance.

To overcome these water quality problems a dredging restoration project was initiated and completed in the fall, 1979. The dredged material was either placed on cropland as a soil conditioner or in an unused gravel pit.

The benefits of the Lilly Lake restoration project are recreational, property value enhancement, aesthetic amenity, improved land for wildfowl, and educational.

Recreation

The number of user-days on Lilly Lake is expected to increase by 10,200: 8,400 non-fishing recreation at a UDV of $2.11 (10/6/8/11/11 = 46) and 1,800 fishing at a coresopnding UDV of $2.42, for a total new recreational benefit of $22,080.[1]

In addition, the volume of improved recreation to existing users must be calculated. Assuming a 10 point increase in environmental quality, or \$.18 increase in UDV, pre-project users, estimated at 4,600 user-days,[1] experience an annual benefit of \$828.

Total recreation benefit is thus \$22,900. This total will not be included as a benefit to be compared to cost since property value increases in theory already count that value. To the extent that the user days are attributable to out-of-area recreators, a proportional value could be added.

A Sportsman Fishing Club was just formed with a present membership of 15. It is expected to expand to 60 members.[4]

Considerably more boating is expected including water skiing, accomodated by a new public ramp that will be built by the Lilly Property Owners Association.[2] This group also plans to double the beach area and provide additional parking. Also, Wisconsin DNR plans to stock the lake.

Aesthetics

Since the project, Lilly Lake has become the cleanest lake in Kenosha County. The dredging has removed the unsightly muck and vegetation from the lake. Also, the increased depth will eliminate winter fish kills. In the past, droves of dead and malodorous fish were found on the shoreline in the spring. Overall, the aesthetics of the lake have improved considerably.

Also, approximately 109,500 cars pass Lilly Lake per year which at \$.10 per car would yield an annual benefit of \$10,950/yr.[1] Again, because of property value theory, this figure is already considered to be included in property value increases.

Property Values

The local realtors[2] indicate that lakefront property has already increased in market value from \$340 per foot to \$500 per foot as a direct result of the project. Some lakefront houses have had their assessed values go up \$9,000. Since 81 percent of the 1.3 mile shoreline is properties, the footage increase is 5,560 (.81 x 1.3 x 5,280 ft.) x (\$500 - \$340) = \$889,600.

It is also likely that the 90 homes set back from the lake have also increased in value. A conservative estimate of 25 percent of the above value (which applied to 80 homes) would add another $222,400 for a total of $1,112,000.

The clearest method of assessing property value increase benefits is to use the approximately 40 percent value by which all homes in the area are expected to increase due to the restoration project. The 180 houses average approximately $40,000 for a total value of $7.2 million.[2] The total project benefit is 40 percent of $7.2 million, or $2,880,000.

Fish and Wildlife

The gravel pit to which spoils were piped now contains an attractive pond with water. Next year the pond will be used for waterfowl production.

Education, Research and Development

This was a pilot project for the hundreds of lakes in the area that have the same problem of siltation. Already people from nearby Brown's Lake and Paddock Lake have visited Lilly Lake to learn about the program. The spreading of the sediment on the farm fields was part of an experiment conducted by the DNR to seek various methods of silt disposal. The establishment of a lake district and other work by local people increases their knowledge of environmental matters.

The local project director also receives many telephone inquiries about the program and visits from other lake district representatives.

SUMMARY OF BENEFITS

LILLY LAKE

Recreation**	+
Aesthetics**	+
Property Values	$2,880,000*
Fish and Wildlife	+
Education, Research and Development	+
Total Annual Benefits (approximate)	$2,880,000
Total Discounted Benefits	$2,880,000
314 Grant Amount	$ 350,000

*Applied to first year only.

**Actual values not included, since property value increase was used to estimate total benefits for this lake.

Data Sources:

1. Lake Management District Project Manager
2. Interviews with local realtors
3. Interviews with local business people
4. Local fishing club

Date of Site Visit: January 18-19, 1980

LITTLE POND

Little Pond is a 68 acre lake in Lincoln County, Maine. It serves as a water supply source for the 550 households (2675 people) in two Maine towns: Damariscotta and Newcastle. Little Pond was closed to fishing by the State of Maine in 1952, and its use is currently restricted to management as a public water supply.[1]

The 314 funding was sought by the State of Maine in order to alleviate the taste and odor problems (and even filter clogging) caused by heavy growths of zooplankton and algae in Little Pond. The restoration technique used was biological control of zooplankton by the introduction of alewives into Little Pond.

Because of the restrictions on the use of Little Pond, recreation and aesthetics will be discussed only briefly. Primary emphasis is on benefits in commercial water treatment and in R&D.

Recreation

Use of Little Pond is restricted to supplying drinking water to Darmariscotta and Newcastle. At present, there is no pressure from the community to lift the restriction, because four other lakes are available for recreation. However, residents of the community do claim that some game-fish are reappearing in Little Pond since its restoration was completed in 1978, and the pond thus has the potential to offer recreational benefits should its use be changed.[1,2]

Aesthetics

Little Pond is a lovely lake in a wooded area a few miles outside Damariscotta. From all reports from the local citizens, the lake has been free of zooplankton since project completion. Community interest in the project has been high, and one may assume that everyone in the water supply area has been there to assess the improved condition of the lake.

One factor contributing to pollution in Little Pond had been a local dump about a mile away. In connection with the Clean Lakes work, the Department of Environmental Protection in the State of Maine also regulated the dump, requiring weekly covering and forbidding open burning. The former regulation reduces the number of gulls visiting the dump (and moving on to increase nutrient loading to the lake), and the latter requirement has reduced particulate matter in air and water.[1,4]

Commercial Water Treatment[1,2]

A substantial portion of the benefits from 314 funding of the restoration of Little Pond can be quantified. These include both benefits to the water company and to the users of the water.

The annual cost to the water company of unacceptable drinking water becomes a large part of annual benefits when the problem is eliminated. These costs were of three types.

First, additional chlorine was required to alleviate taste and odor problems. The Superintendent estimated the net additional use of chlorine by the company due to algal related problems; 11.5 additional pounds of chlorine were used per day from May to November [(11.5 net additional lbs x 214 days) = 2,461 lbs]. Five additional pounds of chlorine were used per day the rest of the year [(5 lbs x 151 days) = 755 lbs]. Chlorine cost the company $35 for 100 pounds in 1975. Yearly savings in chlorine:

$$\frac{(214 \times 11.4) + (151 \times 5.0)}{100} \times \$35 = \$1,126$$

Second, time was spent in answering complaints over the telephone. Assume each of 550 households called once a month during the seven "peak" months, and that each call took 5 minutes of an employee's time. Thus, for each month,

$$\frac{550 \times 5}{60} \times \$3.30^{*} \times 7 = \$1,059$$

is the amount now saved and thus a benefit of the project.

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*This is the Bureau of Labor Statistics average hourly earnings in manufacturing in nearby Lewiston-Auburn area of Maine in 1975.

Third, time was spent in making some house calls to assess the severity of reported problems. The water company superintendent estimates the time required for each house call at about 1-1/4 hours. This time (plus truck depreciation and gas) is $10 an hour. Each trip thus cost $12.50. He made 241 housecalls in 1975 for more severe issues raised in these 3,850 phoned complaints. The cost now saved is $3,012.

Similarly, households using the water from Little Pond during periods of high zooplankton growth had costs associated with poor quality drinking water. They can best be measured by first, time spent in making complaints by phone to the water company, valued at an amount equal to water company cost, $1,059. Second, time was spent in receiving calls from the Superintendent. The number of visits 241 is, of course, the same as those for the Superintendent, but the length of time to receive the call is 3/4 of an hour, and the "opportunity cost" (or implied wage) is only $3.30 an hour. Yearly time spent in receiving calls is 241 x .75 x $3.30 = $596.

Third, many customers paid the cost of obtaining alternative drinking water, either purchasing water in stores or dipping buckets in a spring. Since most did the latter, cost is estimated on the basis of these assumptions: (1) each of the 550 households, on average, made at least one trip per week during the worst three months to the stream to get "drinkable" water; (2) each trip took one hour; (3) the implied wage of one member of the household is, again, $3.30 an hour. The annual cost of obtaining alternative drinking water is 550 x 13 x $3.30 = $23,595.

The total annual benefits of 314 funding to commercial water treatment are $30,400. This, incidentally, does not include the cost avoided by eliminating the need for the water company to install filters, which it presently does not use.

Research and Development or Pilot Project Aspects

Biological control of zooplankton through the use of alewives in Little Pond was an innovative approach to the problem. Previous measures had included annual applications of copper sulfate to Little Pond. This was costly, its benefits were of limited duration, and it was considered responsible for a partial kill of the game fish in Little Pond.[4]

Alewives are an anadromous fish that is easily available to the State of Maine's Department of Marine Fisheries. This makes it possible to restock Little Pond cheaply (approximately $100) if the zooplankton propulation should reappear.[1,2]

Perhaps more important, the results of Little Pond are now being applied with State funding to a second water supply source in Maine. This is the Boothbay Harbor Water System, and its water source is Adams Pond, Boothbay Harbor, Maine.[6]

Miscellaneous Benefits

Benefits of lake restoration also include the knowledge by the community that an acceptable solution to the algal bloom problem had - at last - been found. The condition of Little Pond had been a source of great irritation and concern by the citizens of Damariscotta and Newcastle. the community found previous chemical approaches to the algal problem unacceptable. Copper sulfate had been applied in past years to reduce algal problems. The benefits of these applications were short-lived and resulted in partial kills of the game fish in Little Pond. Chlorine, on the other hand, not only introduced a taste and odor of its own but also did not eliminate the zooplankton which clogged dentist's drills and was sometimes non-filterable. People in other parts of the country may not understand the community's concerns (given their own water supplies), but this irritation by the Damariscotta/Newcastle community is understandable to other residents of Maine, where water quality standards are high (see the discussion in Cobbossee).

SUMMARY OF BENEFITS

LITTLE POND

Aesthetics	+
Commercial Water Treatment	$ 30,400
Pilot Study Benefits	+
Total First Year	$ 30,400+
Total Discounted Benefits	$212,200
314 Grant Amount	9,946.50

Data Sources:

1. Matthew Scott, Chief Biologist, Director of the Division of Lakes and Biological Studies, Bureau of Water Quality Control, Deparment of Environmental Protection, Augusta, Maine.
2. Raymond C. Gudrow, Superintendent, Damariscotta/Newcastle Water Supply Company, Damariscotta, Maine, and his staff.
3. Ron Manfredonia, Director of the Clean Lakes Program, Region I, EPA, John F. Kennedy Federal Building, Boston, MA
4. Mower, Barry, Utilization of Juvenile Alewives to Control Lake Water Quality Problem, EPA Grant Number S 804272010. 1977.
5. Bureau of Labor Statistics, Employment and Earnings: States and Areas, 1939-1975, pp. xix, 320, 323.
6. Letter of January 2, 1980, from Matthew Scott, Chief Biologist, State of Maine.

Date of Site Visit: December 18, 1979.

LOCH RAVEN RESERVOIR

Loch Raven is a 2,400 acre reservoir located in Baltimore County but owned and operated by the City of Baltimore as a source of water supply. (It serves the equivalent of one million people.) It is also a recreational resource for both Baltimore City and Baltimore County residents, the estimated population of which was 1,524,056 in 1979.[3] It is only a 12 mile drive from downtown Baltimore, and it can be reached by private transportation by anyone in the greater Baltimore area within 30 minutes.

Loch Raven is used for recreation that is consistent with correct management of a drinking supply source. Thus, swimming and gas-powered boats are excluded. Uses include warm water fishing, boating (electric motors only), picnicking (no fires including charcoal), skeet shooting, horseback riding, golf, jogging, cycling, and walking. These recreational experiences are made especially enjoyable because of a city-owned buffer-zone of land around the reservoir which varies from a minimum of 400 feet from the water to as much as 1/2 mile. The area is wooded, partly because that is its natural state and partly because the city continues to plant white pines in the area.[1,2,4,5]

The purpose of the 314 grant to Baltimore City Department of Public Works was to install an aeration system in the reservoir to prevent stratification and to ameliorate algal and manganese problems in the water supply. Simultaneously, 208 money was used to identify and monitor pollution sources in Loch Raven's watershed. A watershed plan is almost complete.*

The benefits of 314 funding for commercial water supply are primary. In addition, the aeration system will have an effect on fishing, other types of recreation, and aesthetics.

Recreation

Loch Raven Reservoir is a free source of recreation to the greater Baltimore community year-round. Unfortunately, "hard" estimates of reservoir use are not made, and one must rely largely on qualitative statistics. "Typical" overall park use on weekends between March 15 and October 31 is estimated to be between 5,000 and 10,000 users a weekend.[2] The UDV method of estimating year-round use requires an estimate of "the number of visitors to a recreation area on an average summer Sunday" (in the case of Loch Raven, an average Sunday during the fishing season),* which is multiplied by 50. Assuming 7,500 to be average Sunday volume, one gets an annual estimated use of 375,000 use-days of recreation. This is probably an underestimate of park use.

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*The planning group hopes to interest the University of Maryland and the USDA in using Loch Raven's watershed for a pilot study of agricultural, non-point pollution.

The chief recreational activity of Loch Raven is fishing. Largemouth and smallmouth bass, some northern pike, bluegills, and crappies are caught. The director of the city's boat launch (for which a 50 cent fee is charged) states that 19,700 people used the center for fishing in 1979, and 200 to 300 pounds of fish are caught on average each weekend from March 14 until the center closes on October 31. This is 33 weeks, which means 8,250 pounds of fish are caught from boats (250 lbs x 33 weeks). Fishing on the shoreline is considered to be as good as that from boats, and fishermen are thought to be about 1/2 of park attendance.

The approach taken here to value the benefits of aeration to fishermen is the UDV method. Aeration improves fishing, because it increases the dissolved oxygen in lower portions of the reservoir. This makes conditions more tolerable for fish in summer months. One result of aeration may be that pike are no longer "marginal" fish in the reservoir, and that better game fish will increase in their shares relative to the total fish population. The value of Loch Raven per user day of fishing before restoration is $2.51 (12/3/8/15/12 = 50). This relatively high valuation is due to the good access both to the site and within it. Aesthetics are also high (and can only improve) because of Baltimore City patterns of land ownership and management practices around the reservoir.

Assuming that the recreational experience increases from 12 to 15 points for the existing fishermen in terms of their "recreational experience", the improved quality for existing fishermen is:

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*That the opening of the fishing season is relevant is confirmed by Litter Statistics collected by Baltimore Parks and Recreation. Ten-thousand pounds per month are collected from March 15 to October 31, but 27,000 pounds are collected between March 14 and April 30.

187,500 x \$.06 = \$11,250.

In addition, because there would be some deterioration in Loch Raven because of increasing algae without aeration one can assume some fishing benefits would be lost each year without the 314 project. For fishermen, assume a 2 percent loss of benefits each year. The increment of potential benefits is:

0.02 x 187,500 existing fishermen x \$2.51 = \$9,412

Aesthetics

The aesthetic experience is already good at Loch Raven. This is because of the wooded area surrounding the reservoir, the tasteful signs, and the limited duration of algal blooms. The aeration grant may improve aesthetics somewhat (one or two "points", or 2-4¢), but aeration will primarily retard further decline in water quality as it affects use for drinking water.

Since jogging* and all other recreational activities at Loch Raven except fishing are land-based, the recreational benefit to the other half of park users (187,500 per year) is primarily aesthetic. Using the UDV method, one can assume the aesthetic benefit of improved water quality on Loch Raven is only half that for fishermen - or \$.03 per user day. Thus, improvement to existing users other than fishermen:

187,500 user days x \$.03 per day = \$5,625

Assuming aesthetic experience would otherwise deteriorate by two percent a year, the annual increment of aesthetic benefits protected is:

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*A favorite year-round activity at the reservoir is jogging and walking.[2,6] Loch Raven is the destination each December of the Maryland Marathon, which attracts about 4,000 runners. It is also used for various walk-a-thons for charity. Each Sunday the city closes 1-3/4 miles of reservoir road to traffic in order to facilitate jogging and strolling. Throughout the winter, it is a favorite location for winter hikes in the greater Baltimore area.

187,500 user days x .02 x $2.30 = 8,625

In addition, some commuters from the suburbs to Baltimore cross the four bridges over Loch Raven in order to get to work. Of these, the State of Maryland[6] has estimates only for the average daily use of the Delaney Valley Road Bridge. Eight thousand vehicles per day use it. The aesthetic value to these commuters is: (8,000 vehicles per day x $.03 per day x 365 days) = $87,600.

Commercial Water Treatment

The benefits of improved water quality to the city accrue both to the water company (indirectly to consumers) and also directly to users of the water supply. Each is considered in turn.

The benefits to the water company are of three types. One is savings in chlorine costs each year to handle the water quality problems. Baltimore's Public Works Department estimates that the cost of additional chlorine in 1979 due to manganese problems was $22,820 at its Montebello treatment plants. These figures come from the 153 days (August 1 through December 31) of higher manganese and therefore higher chlorine use - totalling more than 100 tons at $175 per ton. Thus, in 1979 prices, the annual saving in chlorine costs due to aeration would have been $22,820.

In addition, the city saves time and money in answering complaints about water quality. The city estimates that there were 33 days of algal related taste and odor complaints between August 13 and September 15, 1979. Some of the complaints by customers could be handled over the telephone. These complaints to the "water quality" division and to the "water distribution" division totalled about 500 in 1979. Each complaint took about 10 minutes of secretarial time, and the wage rate was approximately that for average hourly earnings of manufacturing production workers in Baltimore in 1978, namely, $6.18 per hour. Thus, benefits to the water company in averted complaints (1978 wage rates) is: (500 complaints x .17 hours x $6.18) = $525.30. This is an annual saving. Public Works has also priced out complaints that cannot be handled over the phone using 1979 data on wages (for technicians, laboratory analysts, and those who do the flushings, when required), and for gasoline and truck depreciation. The total cost of the 150 complaints was $2,121.89 in 1979. Assuming that this cost is eliminated by the aeration system, the annual benefit of aeration in reduced complaint costs is $2,121.

In addition to costs to the company, there are dis-benefits to the consumers of Baltimore's water supply without aeration. One is the nuisance of using unpleasantly tasting and smelling water. Water is purchased for drinking purposes in order to avoid drinking "bad" water. There is no way to obtain estimates of the number who purchase water in a city the size of Baltimore. Assuming half of the one million customers of Loch Raven Reservoir purchased one gallon of water per week during the four weeks of the 33 day algal bloom and that each gallon costs $.75, the cost to them was (500,000 x $.75 per gallon x 4 weeks) = $1,500,000. This is an annual cost.

In addition, customers who made complaints have an "opportunity cost" for the time spent making calls and receiving house visits. The "opportunity cost" is the 1978 Baltimore wage rate used earlier, namely, $6.18, and time spent averages 10 minutes. For telephone compliants (only) the cost is: (500 complaints x .17 hours x $6.18) = $525.30.

For customers calling and then receiving house visits, the cost is: (150 complaints x 1 hours per complaint x $6.18) = $927. Both become annual benefits of aeration.

Education, Research, and Development

Education and R&D benefits from the reservoir are of two types. One is knowledge of the impact of aeration on a really big reservoir with both algal and manganese problems. In addition, there will be educational benefits to laymen in the Baltimore area. The city plans to build an observation deck near the site of the aeration project. School children as well as adults may find this study of "bubbles" on Loch Raven useful in understanding pollution problems and a way to alleviate them.

SUMMARY OF BENEFITS

LOCH RAVEN RESERVOIR

Recreation	
Improvement for existing users	$ 11,200
Protection of recreational benefit for existing users	9,400*
Aesthetics	
Improvement for existing recreational users	5,600
Protection for existing recreational users	8,600*
Improvement for existing commuters	87,600
Commercial Water Treatment	1,526,900
Education and R&D	
Specialists	+
Laymen (through the observation deck)	+
Total First Year	$ 1,750,100
Total Discounted Benefits	$11,944,100
314 Grant Amount	$ 150,900

*Increases by this amount each year.

Data Sources:

1. Division of Water Quality, Department of Public Works, City of Baltimore, MD.
2. Department of Parks and Recreation, city of Baltimore, MD.
3. Budget and Fiscal Office, City of Baltimore, MD.

   Various brochures, including:

   4. City of Baltimore, Department of Public works, Bureau of Operations, Watershed Regulations: Regulations Governing Loch Raven, Prettyboy, and Liberty Reservoirs, 9/1/79.
   5. Maryland, Department of Natural Resources, Fisheries Administration, A Fisherman's Map of Loch Raven Reservoir.
   6. McKerrow, Stephen. "For Families: Winter Hiking". The Evening Sun. January 10, 1980.
7. Maryland State Highway Department.

Date of Site Visit: January 4, 1980.

MEDICAL LAKE

Medical Lake is located in a town of the same name, about 14 miles west of Spokane, in Spokane County, Washington. The lake is entirely spring-fed and is unusually deep - 60 feet at the deepest spot, and 33 feet average depth. It received its name because of the belief that its waters had medicinal properties; they are, in fact, high in sodium bicarbonate. In the early part of the 20th Century, spas and bathing pavillions were in operation there.

The population of Medical Lake is 2,600.[1] However, users are drawn from throughout Spokane County, population 320,000. A relatively small portion of the shoreline (approximately one-third) is in private ownership.[5] State institutions own and permit public use of at least one-third, and the town operates boat launching and swimming facilities on parkland. Prior to the restoration project, lake use was relatively low, primarily because of massive blue-green algae blooms and resulting low dissolved oxygen, obnoxious odors, and general unattractiveness. Rooted aquatic plants interfered with use of the public beach area.[1,2]

The project consisted of chemical treatment of the lake with aluminum sulfate to precipitate phosphorus and particulate matter and to form a bottom seal. The only remaining known point source, a cooling water discharge high in phosphorus, was eliminated. The work has been completed, with dramatic results: water has been clear and bloom-free for two seasons, and rainbow trout, stocked by the state, are thriving in water which previously would not support them.[4]

The alum treatment produced almost immediate benefits in terms of recreation, aesthetics, and fish and wildlife. It is also having a positive impact on property values and has acted as a catalyst for additional community projects.[1,5] The benefits are discussed briefly below and summarized in the table at the end of this section.

Recreation

Long-term residents of Medical Lake who were interviewed stated that only within the past two years have they found the water attractive enough for swimming. The largest number of people using the park on a weekend for any purpose was 100 prior to the restoration project. Since its completion, shorefront homeowners swim in the lake and weekend park usage has risen to between 750 and 1,000. Two lifeguards have been hired for the town beach. The lake has not yet been opened to fishing, pending the outcome of biological and chemical monitoring, but when it is, usage is expected to be limited by regulation from 7,500 to 10,000 angler-days per year. (The maximum could be as high as 25,000 to 30,000, if no limit were imposed.)

Before restoration, approximately 50 people used the lake each weekend day during the seven-month season. Assuming that half as many would visit the lake on a weekday, one can calculate pre-restoration use as:

$$(60 \times 50) + (154 \times 25) = 6,850$$

Using a UDV of $1.44 (2/3/5/10/0 = 20) to evaluate pre-project benefits:

$$6,850 \times \$1.44 = \$9,864$$

Following similar reasoning for post-project benefits, and incorporating an increased UDV of $1.93 (12/3/5/10/10 = 40) because of improved quality,

$$[(60 \times 375) + (154 \times 188)] \times \$1.93 = \$99,302$$

The project thus produced $89,400 in net new benefits. To this can be added, beginning in 1981, benefits of 7,500 angler-days of fishing at a UDV of $2.28 (40 points):

$$7,500 \times \$2.28 = \$17,100$$

Aesthetics

In addition to the impacts on recreation described above, the absence of obnoxious odors from the lake, which could pervade the entire town, has been of definite benefit. This benefit, not explicitly measured, is reflected in property value increases.

Fish and Wildlife

Game fish were unable to survive in Medical Lake prior to the project, principally because of dissolved oxygen depletion during and after algal blooms.[4,6] Since the project, rainbow trout fingerlings stocked by the state have grown to two-pound size and the lake appears to be developing a balanced fish community.

Property Values

In the early 1970's, a lot with a 50-foot frontage at the lake was valued at about $1,000. In 1979, the same lot was worth approximately $10,000. If one assumes that half of that increase was due to inflation and general appreciation of land values, one is left with a conservative

$$50 \times \$4,500 = \$225,000$$

increase in the value of the approximately 50 lakefront properties. As the owners and occupants of these properties were probably not counted among park users, this value can be added to total project benefits.

Research and Development[6]

The apparent success of the alum treatment and the results of the monitoring programs being conducted have attracted considerable attention among lake restoration specialists and in the scientific literature. EPA has in progress a capsule report to publish the project as a case study. It will thus serve as a prototype for other restoration projects.

Community Environmental Activities

All individuals contacted have felt that the project was a resounding success. The Mayor of Medical Lake describes the town's share of the project as "the best money we've ever spent." With the improvement in the lake, the town has been able to attract state grant money for park improvement.

SUMMARY OF BENEFITS

MEDICAL LAKE

Recreation	$ 89,400*
Aesthetics	included in property value and recreation
Fish and Wildlife	included in recreation
Property Values	$225,000**
Research and Development	+
Community Environmental Activities	+
Total First Year	$314,400+
Net Present Value, 10 Years	$931,700
314 Grant Amount	$128,217

*17,100 annual fishing benefit can be added beginning in third year; included in net present value.

**A one-time benefit added in first year although not realized until sale.

Data Sources:

1. Town Administrator, Medical Lake
2. Mayor, Medical Lake
3. Medical Lake Chamber of Commerce
4. Washington State Fish and Game Commission
5. James S. Black, Realtors
6. Dr. Ray Saltero, Eastern Washington University

Date of Site Visit: January 7, 1980

MIRROR AND SHADOW LAKES

Mirror and Shadow Lakes are side-by-side, separated by a short stream by which the smaller lake, Mirror - 13 surface acres, empties into Shadow - 43 surface acres. They are considered as one project because the restoration techniques applied to Mirror have an effect on both Mirror and Shadow, in addition to the effects of separate restoration techniques on both lakes. The lakes are situated on the edge of the rural town of Waupaca, in north-central Wisconsin. The town of Waupaca has a population of 4,342, and there are 425,000 people within a one-hour drive of Waupaca.

Mirror Lake has a public park along approximately twenty percent of its shoreline. The remainder of the shoreline is approximately 20 older houses. The lake has a mean depth of 26 feet and a maximum 43-foot depth. Recreation activities on the lake consist of boating, fishing, swimming, and winter activities, while the facilities in the park provide for picnicking and boat launching.

Approximately one-third of Shadow Lake's shoreline is public area and includes a public bathing beach, a public park and a boat launch facility with parking. The lake is used for swimming, boating and winter sports. During the winter a skating rink is created on the ice and receives extensive use. Ice fishing is also conducted on the lake. Three shelter homes are also contained in the park.

Mirror Lake was showing degradation in water quality attributable to the nutrient loadings from the sewered stormwater. The eventual effects of the nutrients were to cause algae blooms and depress dissolved oxygen in the hypolimnion. Shadow lake had better water quality although it was showing signs of deterioration including reduced dissolved oxygen levels. *Oscillatoria rubescens* was the dominant algae present and was even in the ice, giving it a red color and an odor when melting.

The restoration techniques utilized for Mirror focused on reducing the nutrient loading, improving mixing, and blanketing the nutrients in the bottom. The two storm sewers feeding Mirror Lake were diverted to the Waupaca River. An aerator was purchased and is turned on for short periods of time in spring and fall to assist mixing. Alum was applied to precipitate nutrients and seal the bottom. Although the only restoration technique applied to Shadow Lake was alum treatment, the effects of the Mirror projects will be felt in Shadow.

The benefits that have accrued from this project are recreational, long-term property value protection around Shadow Lake, improved public health, reduced pollution, and education.

Recreation and Aesthetics

Mirror and Shadow Lakes are the only lakes for which site-specific recreational and aesthetic benefit survey results were discovered. A study conducted by economists from the University of Wisconsin under on the lake restoration R&D grants made available through EPA's Corvallis Environmental Research Laboratory has produced the following preliminary results:[7]

- Approximately 80,000 user-days will be spent at Mirror and Shadow Lakes annually.
- Users surveyed indicated willingness-to-pay $.62 and $.91 for a day of recreation at Mirror and Shadow, respectively, in their pre-project condition.
- The same sample would be willing to pay $1.14 and $1.51 for the same recreational experience if water quality were excellent.

This information can be used to estimate recreational and aesthetic benefits. The value of improved water quality is evidently $.52 ($1.14-$.62) at Mirror Lake and $.60 ($1.51-$.91) at Shadow Lake. Assuming that 80,000 user-days are distributed equally between the two lakes, the mean of the two values, $.56, multiplied by 80,000, yields an estimated annual project benefit of $44,800.

Property Value

The Waupaca tax assessor[2] and a local realtor indicate that property values around the lakes have not increased in market value nor have they been assessed higher as a result of the project. However, they both estimate that in the case of Shadow Lake the project was necessary to protect the long-run property values. The houses surrounding Mirror Lake are old. The long-term protection value for the homes around Shadow Lake could not be quantified.

Public Health

Prior to the project swimmers in the lakes were bothered by infections. Since the project, there have not been any infections from the water.[6]

Educational

The University of Wisconsin uses the lake as a field research station.[2] In addition, the Wisconsin DNR has a research and demonstration grant for this project.[1]

SUMMARY OF BENEFITS

MIRROR AND SHADOW LAKES

Recreation and Aesthetics	$ 44,800
Property Value	+
Public Health	+
Education	+
Total First Year	$ 44,800+
Total Discounted Benefits	$312,700
314 Grant Amount	$215,000

Data Sources:

1. Wisconsin Department of Natural Resources
2. City of Waupaca
    a. Water Department
    b. Recreation Deparment
    c. City Clerk
    d. Tax Assessor
3. Local Realtor (Petersen)
4. Chamber of Commerce
5. Bait Shop
6. Local Residents
7. Lowell Klessig and Steve Lovejoy, University of Wisconsin, unpublished data.

Date of Site Visit: January 9-10, 1980

MOSES LAKE

Moses Lake is a 6,800 acre lake located in Moses Lake, Washington. Approximately 20,000 live in the general vicinity. The central location of the lake makes it a popular recreational area for local residents and tourists.

In recent years, nutrient enrichment of Moses Lake has threatened its use as a recreation site. The first stage of restoration began in 1977 when dilution water was added to Parker Horn via Crab Creek. Construction of a transmission line to add dilution water to Pelican Horn is scheduled to begin in 1980. A third stage, addition of dilution water to the main lake, is still under discussion. The success of Parker Horn dilution is currently being evaluated through water quality testing.

Projected benefits from the improvement in water quality are primarily in areas of recreation and aesthetics.

Recreation and Aesthetics

A number of parks, including three parks run by the City of Moses Lake, an Irrigation District Park, Moses Lake State Park, and Big Sun Resorts (a private campground), are adjacent to the lake. Recreation uses before the improvement were all water-related activities and included swimming, fishing, water skiing, ice fishing, and sailing. Recreation uses after the program are expected to be the same, but of higher quality, due to aesthetic improvements.

Usage, capacity, and fee estimates for the parks are as follows:

Park	Use or Capacity	Fees
(1) Irrigation District	50 trailers/busy weekend[1] est. 500 trailers in 1979	$2.00/trailer[1]
(2) Moses Lake State Park	159,463 day users in 1979[3]	--
(3) Cascade Park	40 unit capacity est. 1560 (1978) est. 1270 (1979)	$3.75-$4.75/unit (increase to $4.50-$6.50) in 1980)[2]
(4) Big Sun Resorts	50 spaces, full hookup 6 spaces, heat[3]	@ $5.50-$5.75 $4.00[3]

While Big Sun was full during the 1978 season, it was not in 1979, due to the gasoline shortage.

State park officials estimate a 5 percent to 10 percent[4] increase after the project, or, assuming an increase of 7.5 percent, an annual increase of approximately 12,000 day users. Assuming the following factors yields a supplementary projection of 6420 users:

- No increase at Big Sun or Irrigation District
- An annual increase of 290 trailers at Cascade Park, to the 1978 level, or, assuming 4 campers per trailer, an annual increase of 1160 lake site users
- With the restoration of McKosh Park, as currently planned by city officials anticipating significantly greater lake use due to the improvement, an annual increase of 5260 users.

The estimate of 18,420 increased users due to the improvement is conservative, in part because it excludes users at a new private campground built near the lake last year. Applying the estimated $2.19 after project unit day value (10/10/9/10/8 = 47) to the user increase yields an annual benefit level of $40,340.

The UDV before the project was estimated at $1.97 (10/10/9/10/2 = 41). Consequently, existing lake users experienced an increase in recreational and aesthetic benefit of $.22 per user-day. Using 1979 statistics and the assumptions made in projecting the new increment of usage, existing usage was approximately 165,000 user-days. The increased benefit to existing users was therefore

$$\$.22 \times 105,000 = \$36,300$$

Agriculture

Although the lake is used to irrigate approximately 3000 acres of farm land, improved water quality will not significantly affect local agriculture. In addition, 40 acres of lawn at Moses Lake State Park are irrigated from the lake. Low acreage farms in the area grow alfalfa, wheat, potatoes, and corn and, while farmers are highly conscious of BMP, there was no farmer involvement with the project. It is held that nutrients in the lake irrigation water are actually good for the crops.[1]

Property Value

While, with at least five new developments, there is much new development around the 105 mile lake shoreline, it is not expected that the improvement will increase property values. Property values are already high in that, for example, a lot which sold for $8,000-$11,000 several years ago now sells for $25,000. The lake is used, however, as a selling point for the area.[7]

Commercial Fishing

There are indeterminant commercial fishing benefits from the improvement. One fisherman, with an annual catch of 1000 tons, uses the lake.[6] There may also be minor educational benefits, as a local college uses the lake as an outdoor laboratory.

Economic Development

While no economic benefits are expected to result from the improvement, in part because the town is not highly dependent on tourism, local officials generally feel that the lake is underused and that the improvement will significantly improve lake use. While the resultant benefits are primarily recreational, related benefits are aesthetic and non-quantifiable. However, both water clarity and the diatom population increased after the pilot dilution water was added.[6] There is some concern that water weed, brought in by the dilution water, will hurt recreational lake uses.[7] There is also some concern, based in part on a 1979 accidental sewage spill which brought about beach closings, about the lake's point source, a sewage plant with a 2mgd capacity.[5] However, while the plant contributes 4.4% of the lake's nitrogen levels and 19.7% of its phosphorus levels, it is currently being improved under another grant.[6]

SUMMARY OF BENEFITS

MOSES LAKE

Recreation and Aesthetics	
New users	$ 40,300
Existing users	36,300
Commercial Fishing	+
Educational	+
Total First Year	$ 76,600
Total Discounted Benefits	$ 534,700
314 Grant Amount	$3,251,000

Data Sources:

1. Moses Lake Irrigation and Rehabilitation District
2. City of Moses Department: Parks and Recreation, Health
3. Big Sun Resorts
4. Region III Washington State Parks and Recreation Commission
5. Grant County Health District
6. "Moses Lake, 1977 Pilot Project" Vol. I and II
7. Ebel and Associates Real Estate

Date of Site Visit: January 14, 1980

NUTTING LAKE

Nutting lake is a 78 acre largely spring-fed lake in Billerica, Massachusetts. Billerica, a town of about 40,000 residents, is about 20 miles northwest of Boston and in the vicinity of Lowell.

There are about 35 year-round residents with property on the lake. There are 634 houses in Nutting's small watershed of 372 acres.[1] Most of these houses are former summer residences which have been converted to year-round use. They are now low-to-moderate income housing and generally need substantial work. The area was sewered in 1975 with 201 funds allocated to the Concord River watershed, and some homes are still not connected to the system.[1]

Nutting Lake was basically unusable for any warm-weather recreational purpose at the time of 314 funding. It was only 4 feet deep, was so overgrown with aquatic vegetation that it was impossible to launch a boat; and had deep organic sediment accumulation. Swimming was explicity prohibited by the Board of Health.

The objective of the project is to improve recreational possibilities. The major in-lake restoration technique is dredging. Money has also been spent by the City to purchase 15 additional acres of wetlands for conservation purposes and for a second, public beach area, and also for educating the residents of the watershed in good land management practices as they relate to water quality.

The benefits of the project are in these areas: recreation, property values aesthetics, education, area unemployment, public health, and R&D.

Recreation

Nutting Lake is expected to improve from its 1975 condition in which it was an aesthetic "eyesore" to the community and a recreational disaster (zero use in summer) -- to a lake with a full range of recreational activities. These regained opportunities will be swimming; fishing (at least bass, perch, and pickerel); boating, especially rowboats and sailboats; and strolling in the city-owned 41.5 acres of land.

Last summer, dredging was completed on one portion of the lake, doubling the depth to about 11 feet. Already boating has picked up, and there was, by coincidence or not, a return of wildlife (Canada geese and blue herons) to a protected nesting sanctuary on a small island in the lake.

The benefits to recreation of restoring Nutting Lake can be quantified using the UDV method. The value of Nutting Lake per user day prior to restoration was about $1.44 (2/7/3/7/1 = 20). Recreation and aesthetics are positive numbers only because Nutting Lake was used in winter for ice skating and some ice-fishing. Direct impacts of the 314 grant are in three areas: recreation, access, and environmental quality. Recreation will improve so that a full-range of summer activities, including swimming, are again possible. Access has been improved by the purchase of land for a new beach area. Environmental quality is improving as dredging removes the heavy vegetation.

Because federal funding of Nutting Lake continues to be interrelated in time and design, however, an improved Nutting Lake will be a joint product of 314, 201, HUD and other federal funding. Thus, it is difficult to assess the impact on user day value of only 314 money. Omitting HUD financing, however, the value of Nutting Lake per user day will probably increase 18 points (9/7/6/10/6 = 38), to $1.88.

There is considerable speculation about the numbers of people who will actually use Nutting Lake when its water quality is restored. The nearest source of freshwater swimming to Billerica is Waldon Pond in Concord, Ma. The range of potential users varies from those in the watershed itself (about 2400 people) to those in Billerica and five surrounding communities (population: 135,000).[2] Given the small size of the lake and also the low-income housing in the area, local expert opinion[1,2] speculates that the chief users of the restored lake may only be watershed residents and their friends.

If one assumes (conservatively) that the only users are watershed residents, future lake usage is 2409 people (634 houses x 3.8 people per household).[2] If all 2409 people use it each Sunday in summer and if 50 times this is an acceptable measure of year-round use, the value of increased recreation use is:

(2,409 people per summer Sunday x 50 x $.36) = $43,465.60

Aesthetics

Nutting Lake will dramatically improve from its present distasteful appearance with lake restoration. An estimate of a gain in "environmental quality" from "1" to "6" is clearly warranted even before homes on the shoreline are rehabilitated with HUD money. The impact of changed aesthetics affect residents of the watershed more severely than non-residents.

Given the street plan of the watershed, residents must drive past Nutting Lake even for groceries or schools. Assuming each person makes 3 trips past the lake each week (3 x 52 = 156 trips/yr.), the value of the improved aesthetics to existing home-owners is:

(2409 people x 156 trips per year x $.10) = $37,580.40

Assuming aesthetics would further deteriorate without restoration by 2 percent a year, the value of protecting the existing benefit is:

(2409 people x 156 trips per year x .02 percent decline x $1.44) = $10,823.16

The 2 lane Middlesex Turnpike (Route 3A) passes Nutting Lake (in fact, it "divides" it in half). Anyone travelling on this 35 mph road can clearly see the signs of deterioration in water quality. Five thousand vehicles per day used Route 3A in 1975. The Northern Middlesex Planning Commission feels that at least 7,500 vehicles per day passed the lake in 1979 because of the enormous growth in population in Billerica and surrounding communities.

Using this figure, both the value of improved aesthetics and of protecting benefits for existing drivers can be calculated. It is assumed there is one person per car. Thus, the value of improved aesthetics to existing drivers (non-lake residents) is:

(7,500 cars per day x 365 days x $.10) = $273,750

The value of protecting this benefit assuming a 2 percent decline a year is:

(7500 cars per day x 365 days x .02 percent decline x $1.44) = $78,840

Economic Development

The 314 grant encouraged HUD to consider Nutting Lake and its watershed for a $291,000 grant to rehabilitate its housing. This grant award (under the Small Cities program) was made in early January, 1980. The program will finance some final sewer hook-ups; will give rebates to some homeowners who improve their property; and will subsidize home improvement loans to others. (The amount available to each homeowner varies with his income level and his need to remove housing code violations.)[2]

Although much of the dredging and spoil containment area work is a matter for skilled personnel, this 314 project has also used a number of local people who would otherwise be unemployed. Six Youth Corps members of the Billerica community have found employment for 13 weeks each summer with the restoration work. This is an "employment" effect of adding six to the labor force, and the program will last five years. In monetary terms, the addition to Billerica total income statistics is:

$$6 \times 13 \text{ weeks} \times 40 \text{ hours} \times 3.10 = \$9,672$$

In addition, four CETA people have been used in the past, 1 for 18 months and 3 for 3 months. However, since they are paid with Federal grant funds, the direct benefit cannot be included.[1]

Property Values

The restoration of Nutting Lake should have a significant impact on property values in the watershed. One or two people have already improved the siding on their homes in anticipation of improved water quality. With HUD rebates and low-interest rate loans, many more property owners in the Watershed are expected to improve their housing.

The result of these joint activities in the Watershed area may be a substantial gain in property values. No one in Billerica (tax assessors or local real estate agents) can hazard a guess about the dollar value of these future property improvements.

Education and R&D Benefits[1,2,3]

The 314 restoration of Nutting Lake has considerable R&D benefits. The entire dredging operation is considered a pilot project by the Commonwealth of Massachusetts, because it is the first dredging operation in the state. The floculation process is of special interest, because there will be chemical treatment of water before it is released into Mill Brook. Reforesting the nutrient-rich dredged spoil at the completion of the dredging process is a pilot project. The University of Massachusetts will attempt to re-forest the spoil with high-quality, deciduous trees - oak, cherry, walnut, and hickory - and will monitor their growth.

There will be some educational, or "demonstration," effects to other lakes in that part of Eastern Massachusetts. Most of them are badly polluted, and most of them have mill workers' former summer homes, which have been converted to year-round use. Nutting Lake's ability to "pull itself up" or as the local newspaper put it, "From Resort Mecca to Shantytown to..." - may encourage other Eastern Massachusetts towns with the same problem to attempt to solve it.

SUMMARY OF BENEFITS

NUTTING LAKE

Recreation	
Protecting Existing Use	+
Increased Use	$ 43,400
Property Values	+
Aesthetics	
Residents of Watershed:	
Aesthetics Improved	37,600
Aesthetics Preserved	10,800*
Non-residents of Watershed:	
Aesthetics Improved	273,800
Aesthetics Preserved	78,800*
Public Health	+
Unemployment and Income Effects:	9,700**
Education and R&D Benefits	+
Total First Year	$ 472,200+
Net Present Value	$5,292,100
314 Grant Amount	$ 241,159

*Increases by this amount each year.
**First five years only.

Data Sources:

1. Billerica Conservation Commission
2. Northern Middlesex Regional Commission
3. EPA, Region I.
4. Census Division, Commonwealth of Mass., 1975 Decennial Census
5. Michael Medeiros, Natural Resource Lands of Billerica. BCC.
6. Purcell and Taylor. Interim Report on Water Quality Analysis. Aquatic Vegetation Analysis and Containment Area Preliminary Design October 1977

Date of Site Visit: January 11, 1980

PENN LAKE (LOWER)

Penn Lake is a shallow, 31-acre body of water having its origin as a small lake associated with glacial moraine. It is located within the City of Bloomington, a suburb of Minneapolis, Minnesota and there is a population in excess of 160,000 in the immediate vicinity.

In March of 1976, Federal assistance was requested, in order to restore Penn Lake. The majority of the work was to be directed towards construction of sedimentation basins, access areas, and improvement of lake waters aesthetically. Lower Penn Lake receives urban runoff directly and from upper Penn Lake as well. Prior to the project, the lake fell to low level during mid-summer, creating exposed sediment flats with decaying organic matter and a general unsightly appearance.

Because the lake receives urban runoff and will continue to in the future, a pumping system has been installed at the north end of the lake. This pump withdraws groundwater at a rate of 300 g.p.m. from a deep aquifier. It then runs down a stepped race and is deposited, following aeration (up to 12 mg/l of dissolved oxygen) in Penn Lake. The presence of an aerated fresh water source enables fish to survive during periods of low oxygen during summer and winter and will, it is hoped, prevent winter kill of fish in this shallow lake. Placement of sediment traps which permit access and cleanout will undoubtedly reduce the distribution of sediments with their enriching nutrients. It remains to be seen whether these measures will be enough to slow eutrophication in the Penn Lake ecosystem over the long term.

Principal benefits are recreation, aesthetics, economic development, fish and wildlife, and reduced lake management costs.

Recreation

Before the program was initiated, neither fishing nor boating were possible on Penn Lake. The lake is free of ice for approximately one half year, or 180 days. No values are currently available on recreational use of the Lake, however, as many as 25 individuals have been seen fishing at the lake on Sundays.[3] Facilities in the vicinity of the lake include public access, parking, a fishing pier and beach (although there is no swimming).

Boating is reported to be a fairly common activity on the lake. No values are available which would indicate the extent of this use, but national statistics indicate that it would occur at 75 percent of the fishing usage, or 19 user-days on Sunday.* Both usages can be multiplied by 50 to estimate total annual usage.** There are thus 1,250 use days of general fishing annually, plus an unknown amount of ice fishing. At a UDV of $2.60 (18/8/10/11/7 = 54), this represents a benefit of $3,250. A corresponding UDV of $2.37 for general recreation, times 950 boaters, yields a benefit of $2,250.

Aesthetic Enjoyment

Because of its location in a suburban setting, Penn Lake is enjoyed by hundreds of people each day. Correspondingly, if the lake is an eyesore a vociferous minority will be manifestly displeased and make known their unhappiness to responsible officials. If it is assumed that only 500 people per day take pleasure in seeing the lake in a healthy state then 500 x 365 days = 182,500 persons per year. Assuming the increase in UDV is $.09 (5 points in environmental quality), then $16,425 is the value of the general aesthetic experience.

Flood Control

Initially there was some manipulation of the outfall. However, the citizens did not approve . Consequently, the outfall which was lowered 1 foot was restored to its present level. The City is sensitive, however, to any flood control measures that may need to be taken.

Economic Development

Both Bloomington and the area around Penn Lake are well diversified commercially and industrially. The project itself will generate local jobs. It would also be expected that the project will benefit local businesses.

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*U.S. Department of Interior, Bureau of Outdoor Recreation, "The 1970 Survey of Outdoor Recreation Activities Preliminary Report". 1972.

**See Appendix C for Methodology.

Fish and Wildlife

Reduction of winter kill and water level and dissolved oxygen fluctuations will help in the maintenance of a balanced fish community in the lake.

Research and Development

Although there is no research program per se on Penn Lake, it is likely that the Minnesota Pollution Control Agency and the Fisheries Division of the Minnesota Department of Natural Resources, will take a much greater interest and will dedicate staff and facilities to urban lake management problems.

Reduced Lake Management Costs

The project will slow cultural eutrophication and consequently reduce the necessity for and difficulty of dredging Penn Lake. The construction of sediment traps within the lake should reduce the costs of future dredging by localizing sediment deposits within easy access - by 50 percent, one can assume - from \$3.00 per cubic yard to \$1.50 per cubic yard. Watershed management is expected to reduce phosphorus loading by approximately 50 percent; if the same reduction is experienced for sediment, dredging would be needed only half as often. Assuming that 50,000 cubic yards will have to be removed from the lake in 20 years without the project, the project would postpone dredging until the passage of 40 years. The benefit is the present value of the savings resulting from postponing dredging for 20 years and reducing costs by one-half:

$$(50{,}000 \times \$3 \times 1.07125^{-20}) - (50{,}000 \times \$1.5 \times 1.07125^{-40}) = \$33{,}100$$

SUMMARY OF BENEFITS

PENN LAKE

Recreation	$ 5,500
Aesthetics	16,400
Economic Development	+
Fish and Wildlife	+
Research & Development	+
Reduced Lake Management	33,100*
Total First-Year	$ 55,000
Total Discounted Benefits	$186,000
314 Grant Amount	$ 87,900

*Present value of a one-time benefit, applied in first year only.

Data Sources:

1. City of Bloomington, Dept. Public Works
2. Minnesota Pollution Control Agency
3. Department of Natural Resources (Minnesota)

Date of Site Visit: January 9, 1980

RIVANNA RESERVOIR

Rivanna Reservoir is a 390-acre reservoir located in Albermarle County, Virginia. Holding 1.76 billion gallons of water, it is owned and operated by the City of Charlottesville as the only public water supply to the city and to the county.* Rivanna is also a recreational resource for both the city and the county. The total estimated 1980 population of Charlottesville is 43,250, and that of Albermarle County 52,800.[1,3]

The 314 grant was used for two purposes. One was to install an aeration system in the reservoir to reduce taste and odor problems resulting from algae blooms. The other was to analyze and monitor pollution problems in the watershed due to point (24 percent) and non-point (76 percent) discharges. Certain projects in the 155,000 acres of the reservoir's watershed are now completed - specifically, studies of the effects of agricultural grassed waterways and of a residential sedimentation pond.

There are several benefits from the 314 project to Charlottesville and Albemarle County. The primary ones are in current commercial water treatment and in research and development as it will impact future water treatment. In addition, there are some recreation benefits.

Recreation

Recreation activities on Rivanna are largely warm-water game fishing. There is also some boating, mostly by fisherman but also by the crew of the University of Virginia which has a boat house on the reservoir. A local conservation group, Ivy Creek Natural Areas, has bought 80 acres of land on the reservoir in order to provide nature trails to the community.[1]

With the exception of the Ivy Creek Natural Area, public access to the reservoir is limited. Most of the land around the reservoir is privately owned. One exception is the land by the aeration system and dam, where there is a narrow road maintained by the Rivanna Water and Sewer Authority and also a boat launching ramp. The other is by Route 29N, where there is also a boat launching facility.

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*Some people in Albemarle County have wells and do not use the commercial water supply.

The Commonwealth of Virginia, Division of Game and Inland Fisheries has up-to-date estimates of the kinds of fish in the reservoir (collected from two types of samples) and also a rough estimate of the number of fisherman per year. The fish are largemouth bass, bluegill, both black and white crappie, channel catfish, and both yellow and brown bullhead. Existing annual fishing usage is estimated by Virginia to be 30,000 user-days.

Using the UDV method, Rivanna is given an initial value per user day of $1.68 (4/5/4/5/12 = 30). This relatively low value is partly due to the necessary restriction of recreational opportunities on a commercial water supply source. Rivanna also has only fair access roads and public boat launching facilities.

Recreation is judged to increase 3 points ($.06) after aeration. This is for two reasons. One is increased fishing opportunity that results from raising the concentration of dissolved oxygen in they hypolimnion making the situation more tolerable for fish in summer. The other is due to the land purchased by a private group for nature trails, an additional recreational opportunity to the community. While the latter was not paid for by the 314 grant, it coincided with - and was reinforced by - Federal and local interest in improving water quality in the Reservoir.

Recreation

The benefit per year of improved water quality to the existing 30,000 fishermen is:

30,000 fishermen x $.06 = $1,800

Assuming that fishing opportunities would have deteriorated by 2 percent each year without aeration and reservoir management, the annual benefit to existing users of protecting fishing are:

30,000 fishermen x .02 x $1.68 = $1,008

Boating on Rivanna is primarily by fishermen.[1,5] An exception is the crew of the University of Virginia, which has a boat house on Rivanna. The estimate is that 50 people per day use shells from September 1 - November 15 and also from March 1 - May 15, a total of 152 days.[5] The value to the crew of improved water quality is:

50 people per day x 152 days x $.06 = $456

Since there would have been deterioration of 2% a year without the grant, the annual benefit to protecting the reservoir for the crew is:

50 people per day x 152 days x .02 x $1.68 = $255.36

Commercial Water Treatment[1]

Some of the benefits to commercial water treatment of 314 funding have already been realized. There was no algal bloom in 1979 after the aeration system was working. In previous years, there had typically been a four-to-six-week period of taste and odor problems.

The Rivanna Water and Sewer Authority estimates savings in three areas. One is savings in chemicals to treat the algae; for example, $3,500 worth of copper sulfate was used in 1977.

Secondly, there is savings of time and money to the authority in answering complaints. Rivanna estimates there were, on an average, 20 complaints a day for 30 days each year, or 600 complaints in all. Roughly 500 of these complaints could be handled over the telephone. The bulk of these required only secretarial/clerical time to assure the caller that the taste and odor problems were known to the authority. Others required more technical explanations, thus requiring the time of the superintendent or chemist in answering the phone. These calls each take from 10 to 30 minutes. In the absence of records, Rivanna feels it is fair to say that the 500 calls answered over the phone cost an average of $2.50 per call (a weighted average of 20 minutes of technical and non-technical time, in wages). Thus, an average annual implied benefit of aeration in costs of telephone complaints saved is:

500 calls x $2.50 per call = $1,250

The 100 complaints that could not be handled over the phone required the Water and Sewer Authority to collect a sample of the water from the household or business and then to analyze it. Rivanna estimates this cost at $11.75 per complaint, broken down as follows: $2 in clerical time, $.25 in materials, $5 of a chemist's time, $2.50 in travel costs (gas and depreciation of vehicle), and $2 to analyze. The annual implied benefit of aeration in averted house visits is:

$$100 \times \$11.75 = \$1,175$$

Finally, for those 30 days, an unknown number of customers by-passed the water for drinking purposes. Assuming 40,000 customers have purchased water at $.75 a gallon* for 4 weeks, in the absence of the project, the saving is: (40,000 x $.75 x 4 weeks) = $120,000.

Education, Research & Development

The 314 funding of aeration and of pilot projects in Rivanna Watershed has several educational benefits. It will increase knowledge of how this reservoir responds to changes in reservoir and watershed management. A major result of 314 funding - together with all other studies by the University of Virginia and outside consultants - is the development at this time of a formal watershed management plan for Charlottesville and Albermarle County.

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*A price of $.09 a gallon for purchased water has been suggested by a number of reservoirs - including Rivanna. This is clearly a "wholesale, bulk-purchase" rate. Spring water is currently selling for about $1.09 a gallon in retail outlets in Philadelphia.

SUMMARY OF BENEFITS

RIVANNA RESERVOIR

Recreation	
Fishing:	
Recreational Improvement for Existing Users	$ 1,800
Recreational Benefit Protection	1,000*
Crew - University of Virginia:	
Recreational Improvement for Crew	500
Recreational Benefit Protection for Crew	300*
Commercial Water Treatment	124,400
Education, and Research and Development	+
Total First Year	$128,000
Total Discounted Benefits	$923,500
314 Grant Amount	$ 63,835

*Increases by this amount each year.

Data Sources:

1. Rivanna Water & Sewer Authority.Charlottesville, VA
2. USDA, Soil Conservation Service Charlottesville, VA
3. Engineer & Run-off Control Official, Albemarle County, VA
4. Department of Game & Inland Fisheries, Commonwealth of Virginia, Charlottesville, VA.
5. Crew President, University of Virginia
6. F. X. Browne and Assoc., Rivanna Reservoir Restoration Project May, 1979.
7. Betz Environmental Engineers. Water Quality Management Study of the South Rivanna Reservoir and Tributary Area, June 1977.
8. J. Harvey Baily. Report on Albemarle County Runoff Control Ordinance February 14, 1979.
9. Public Works, Charlottesville

Date of Site Visit: January 20, 1980.

STEINMETZ POND

Steinmetz Pond, located in Steinmetz Park, Schenectady, New York, has a 2.87-acre surface area. Approximately 78,000 people live in Schenectady, with 15,000 in the immediate park vicinity in Northern Schenectady.[2] Most of the pond users are area children who walk to the pond from adjoining neighborhoods.

The pond was completely drained over the winter of 1977-78 to allow for compaction and dessication of the bottom sediments. The sludge was bulldozed out of the pond during the spring of 1978 and by July, 1978, 1.5-2 feet of bottom sediments had been removed, two storm sewers were rerouted and the pond bottom was covered with sand. The lake was refilled with chlorinated city water. The sludge removal and pond restoration resulted in weed elimination, decreased turbidity, elimination of storm sewer pollution and improved pond water quality due to use of makeup city water to supplement the spring water feed. Orthophosphate concentrations were reduced to one-third of pre-restoration lands.[6] The Union College Department of Civil Engineering was deeply involved in the project's engineering and monitoring technique, as well as associated research.

Benefits due to the improvement included improved pond quality for ice skating and swimming, improved public safety, improved public health, educational benefits and aesthetic benefits. In addition, the project served to improve local attitudes toward lake and lake area upkeep.

Recreation

The project improved the quality of swimming by increasing the lake area available to swimming by 50 percent, with the beach area increasing by 15 percent.[4] In 1974 and 1975, swimming attendance in July and August averaged 310 daily. By 1977, the lake was on the verge of being closed for health and safety factors, and swimming usage was essentially non-existent. Current use estimates are 350-400 swimmers/day on weekends.[4]

Other lake recreation uses before and after the program are fishing, which will be insignificant as there is no planned restocking, and ice skating, the quality of which improved due to the project because the skating area increased with the higher water level. The city may also light the pond for nighttime skating. No estimates of skating usage were available.

Assuming that weekend users are evenly distributed over both weekend days, weekend one-day usage can be approximated as

$$\frac{1}{2} \times \frac{350 + 400}{2} = 188$$

Seasonal use can be estimated as*

$$50 \times 188 = 9,375$$

The post-restoration UDV is estimated to be \$1.93 (4/3/7/16/10 = 40). Consequently, annual swimming benefits are approximately

$$\$1.93 \times 9,375 = \$18,094$$

This value will have to serve as an estimate of total recreational benefit, since skating usage was not known.

Aesthetics

Under aesthetics, in addition to improving recrational quality, the restoration not only reduced odor and mosquito problems, but served as an impetus for the removal of debris and litter around the site, as well as the improved maintenance of surrounding lawns.

Flood Control

The associated storm sewer diversion may reduce street flooding.

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*See Appendix C, page C-4 for methodology.

Public Health

The increase in swimming is due in part to public safety and health benefits due to the improvement. There were two drownings, pre-improvement, due to the lake weeds and turbidity. The improvement significantly reduced the coliform count from a pre-improvement level as high as 5,000 total, 1,050 fecal.[5] The value of these benefits is included in the recreation estimate.

Education, Research and Development

Another major benefit of the project was its educational aspect. With respect to education (as well as economics), 15 paid Youth Conservation Corp. enrollees worked at the lake site. Twenty-five Union College students and affiliates worked on lake monitoring, with several classes studying the project. The project had related research and development benefits, as the engineering and dredging techniques served as a pilot for other projects.

Miscellaneous Benefits

Dredged material was used as fill for a football field base.

SUMMARY OF BENEFITS

STEINMETZ POND

Recreation, Public Health and Safety	$ 18,100
Aesthetics	+
Flood Control	+
Economic	+
Education	+
Public Health	+
Total First Year	$ 18,100+
Total Discounted Benefits	$126,300
314 Grant Amount	$ 36,680

Data Sources:

1. New York Department of Environmental Conservation
2. Mr. Tom McCauley, Schenectady City Planner
3. Mr. Bill Cook, former Schenectady City Planner
4. Mr. Bob Frederick, Schenectady Parks and Recreation
5. Mr. Don Klotz, Schenectady Department of Public Health
6. Dr. Phil Snow, Union College, Civil Engineering

Date of Site Visit: January 9, 1980

LAKE TEMESCAL

Lake Temescal is a 10-acre lake located in a park operated by the East Bay Regional Park District, Oakland, California. It is heavily used by residents of Alameda and Contra Costa Counties, combined population 1.6 million, for swimming, hiking, bicycling, horseback riding, and picnicking. The park is 8 minutes from downtown Oakland (population 330,000) by public transportation, and transit service is increased during the summer. San Francisco residents also travel to it.

The lake's 2.4-square-mile watershed contains steep land which has been and is being developed for residential use. Sediment loadings due to erosion from both graded lots and active construction sites has been substantial, and Temescal's primary problem has been siltation. High nutrient concentrations producing algal blooms and coliform counts which necessitated beach closings also contributed to the reduced usefulness and attractiveness of the lake.

A 314 grant was obtained by East Bay Regional Park District primarily to remove sediment from the lake, to make physical changes which would reduce the rate of siltation, and to identify and control pollutant sources in the watershed. During 1978 and 1979, 47,200 cubic yards of sediment were removed from Lake Temescal, which was deepened to 18 feet at its inlet end. A 72-hour detention and settling pond was constructed on Temescal Creek, one of the two tributaries, and a temporary pond with a lake by-pass system was built on Caldecott Creek, the other tributary, for use during the rainy season. A pollutant source identification, monitoring, and control program was initiated and is ongoing; the U.S. Geological Survey is cooperating in that effort.

Primary benefits of the Lake Temescal project are in the categories of recreation, aesthetics, public health, research and development, pollutant reduction, and community environmental activity. These are discussed briefly below and summarized in the table at the end of this section.

Recreation

Typical park use volume has ranged from 500,000 to 750,000[1] use-days per year, with the park open all year and swimming available from May 1 through September 30. A fee of $1.00 per adult and $.50 per child is collected for swimming. Receipts were $30,000 for the May-September period in 1978 and $27,500 for July-September (swimming prevented by dredging in May and June) 1979.[1] Prior to the project, algal blooms, sediment, debris and high coliform counts were reducing swimming use. These conditions have been ameliorated, and the lake is now of such quality that it has been stocked with trout, thus adding a recreational use not previously available.

Assuming that twice as many children as adults use the lake for swimming, 1978 swimming volume can be estimated at 40,000 use-days, based on the $30,000 total of fees. In 1979, one can project $46,000 in fees had the dredging not been in progress for two of the swimming months, or an increase to approximately 60,000 use-days, as a result of the project. The Bureau of Outdoor Recreation's analysis in "The 1970 Survey of Outdoor Recreation Activities, Preliminary Report" (1972) shows that residents of metropolitan areas fish 2.9 days and swim 11.3 days per year. Fishing activity at Lake Temescal would thus be expected to be at a level of 25 percent of swimming, or 15,000 use days, as a result of the project. Direct lake use has therefore increased from 40,000 to 75,000 use-days per year.

At the same time, the attractiveness of the lake has increased. Using the UDV method, values of $1.73 (4/3/8/15/2 = 32) before and $2.32 for general recreation and $2.53 for fishing after the project (15/3/8/15/10 = 51) seem reasonable. Consequently, the following monetary values can be assigned to direct annual lake recreational benefits:

Increased general recreational use
    20,000 use-days x $2.32 = $46,400
Improved quality for existing users
    40,000 use-days x ($2.32 - $1.73) = $23,600
Fishing use
    15,000 use-days x $2.53 = $37,940

In addition, because the lake was rapidly deteriorating, it can be assumed that some recreational value would be lost each year in the absence of the project. Assuming a 10 percent loss of benefits each year, this yearly increment of benefit can be calculated at:

$$.10 \times 40{,}000 \times \$1.73 = \$6{,}900$$

Total direct lake recreational benefits the first year are thus $114,850. The present value of the 10-year benefit stream is shown in the table at the end of this section.

Aesthetics

It can be assumed that all of the average of 625,000 park users derive some benefit from improvement in the lake. For those who are not direct lake users, this benefit will be primarily aesthetic, and its annual monetary value can be calculated, using the UDV method, on the basis of an improvement in aesthetic benefit of $.14 (moving from 2 points to 10 points in the UDV scale).

$$(625{,}000 - 75{,}000) \times \$.14 = \$77{,}000$$

Public Health

Prior to the project, Lake Temescal was closed to swimming an average of 4 days per year because of coliform counts in excess of standards.[1] In 1979 there were no closings. The actual benefit in health terms cannot be quantified, but the annual benefit through the elimination of beach closings can be calculated by:

$$(4 \div 150 \text{ days}) \times 60{,}000 \text{ swimmers} \times \$2.32 = \$3{,}712$$

Education, Research and Development

The source control portion of the project has already added to the store of information concerning non-point sources in urbanizing areas. The whole project has been examined by groups concerned with similar lake problems elsewhere. A day care center next to the lake may use it for educational purposes now that its quality has improved.

Community Environmental Activities

A survey conducted before the dredging began indicated public support for the project. Since then, citizens and contractors have demonstrated continued support by voluntarily implementing various best management practices and the City of Oakland is enforcing erosion controls more strictly. The source control program, with monitoring at a number of stations in the watershed, is the primary cause of this increased attention to non-point source control.

Miscellaneous Benefits

The material dredged from Lake Temescal, 47,200 cubic yards, was used as fill at another park in the district. Park officials estimate that they would have had to pay $1.50 per cubic yard to purchase fill.[1] This one-time benefit can be calculated as 47,200 x $1.50 = $70,800.

SUMMARY OF BENEFITS

LAKE TEMESCAL

Recreation Protected	$ 6,900*
Recreational Use Increase	84,400
Improved Recreational Quality	23,600
Aesthetics	77,000
Public Health	3,700
Education, Research and Development	+
Community Environmental Action	+
Miscellaneous (Value of Dredge Spoil)	70,800**
Total First Year	$ 266,400+
Total Discounted Benefits	$1,112,500
314 Grant Amount	$ 315,618

*Increases by this amount each year.
**A one-time cost included in first year only.

Data Sources:

1. East Bay Regional Park District
2. Grubb Realtors
3. "Lake Temescal Pollution Identification and Source Control Program" (August 1979)
4. "The Economic Benefits Generated for the East Bay Community by its Regional Park System" (June 1978)
5. Various park brochures

Date of Site Visit: January 9, 1980

TIVOLI LAKE

Tivoli Lake is located in the Arbor Hill Section of Albany, NY, bordered by Route 90, Route 9, and Livingston Avenue. The population within the immediate lake vicinity is 38,000, with 109,900 in Albany and 500,000 in the Albany-Troy-Schenectady area.[2] Before the restoration, 90% of Tivoli users had been from within five blocks of the lake.[2] Projected usage will show increases in visitors from the larger Albany-Troy-Schenectady urbanized area. The main lake is 4.75 acres, with 80 acres of associated wetlands, ponds, fields, and uplands.

The Tivoli Lake area is currently under development as a pilot urban wildlife sanctuary which will serve as a model, if successful, for other sites. Restoration techniques will include lake dredging, wetland development to retard storm water runoff, bank stabilization and planting, and earthen dike reconstruction. The dredging of the lake to a maximum depth of 8 to 10 feet is ongoing and expected to be completed in April 1980. The lake was drained early in 1979. Reconstruction of the main lake's dike has been completed, as has the regrading of banks and upland areas around the lake. The project also includes rerouting of two storm sewer lines which emptied into the lake and plugging abandoned sanitary sewer lines.[2]

The lake and surrounding area received less than optimal use before the improvement because of sewage contamination and possible safety problems. Although there was some fishing and hiking, vandalism, motorcycling, and other destructive uses were common. The area was not patrolled adequately.

Other aspects of the Urban Wildlife Environmental Unit's program for Tivoli include:

- Fish stocking program
- Revegetation of 10 acres of surrounding soil
- Construction of two wildlife blinds
- Introduction of interpretative materials, such as guides and signs
- The establishment of a continuing management program
- Development of educational trail system around lakes and wetlands
- Installation of picnic tables.

Because the restoration and development package is designed to provide a package of improved recreational opportunity, aesthetic quality, and educational experience, these benefits are considered in combination. Other benefits are in the areas of flood control, economics, and public health.

Recreation, Aesthetics, and Education

Pre-improvement recreation activities included strolling, fishing, and birdwatching. Post-improvement activities will include skating, as the city is planning to maintain the lake as a skating area, and wildlife-related activities. While 475 fishing trips were made to the lakes in 1977, fishing is expected to improve, with two stocking plans currently under consideration.[7]

In terms of aesthetics, alleviation of the following problems will make the area more attractive to users:

- Raw sewage input, accumulated slugde, and stormwater runoff
- Odor
- Algae
- Indirectly, dumping and vandalism
- Bare or disturbed soil.

Educational groups for which the improvement is likely to increase attendance include the Philip Livingston Junior High School, Albany Boys' Club, and Youth Conservation Corps.

It is estimated that daily attendance will increase from 3 visitors/day (1977 survey results) to, by September 1982, 41.[2] While The Urban Wildlife Environmental Unit computed approximately a $2 per visit cost for 1982, the post-improvement unit day value for Tivoli Lake has been estimated to be $2.43 (20/6/10/11/10 = 57), a $.65 increase over the pre-improvement level of $1.68 (10/6/2/11/1 = 30). This higher value can be said to have resulted primarily from the improvement, as a complement to the wildlife sanctuary development. Assuming a year-round increase in usages of 13,870 (38 times 365) yields an annual value of benefits increase in recreation, education, research and development of $33,700. The existing users (3 x 365 = 1,095) will enjoy increased benefits of $.65 each, or $700.

Flood Control

The project will alleviate erosion problems due to nearby Patroon's Creek flooding,[2,3] occurring several times annually, and certain Tivoli floodings into nearby Pearl Street.

Economic Benefits

Economic benefits concern Youth Conservation Corps employment at the site, notably for work on planting and bank stabilization in the summer of 1980.[4]

Public Health

Public health benefits for site users will result from the project's sewage sludge removal as well as the partial alleviation of mosquito problems, while safety will be improved through the covering and filling of manholes and water system vaults.

SUMMARY OF BENEFITS

LAKE TIVOLI

Recreation	$34,400
Aesthetics	included in recreation
Flood Control	+
Economic Development	+
Public Health	+
Education	included in recreation
Total First Year	$ 34,400+
Total Discounted Benefits	$240,100
314 Grant Amount	$202,645

Data Sources:

1. New York Department of Environmental Conservation
2. Urban Wildlife Environments Unit, NYDEC
3. Albany City Plannning Commission
4. Albany Bureau of Human Resources
5. Albany City Dept. Parks & Recreation
6. Albany Assessor Department
7. NYDEC Urban Fisheries Program
8. Albany County Health Department

Date of Site Visit: January 7, 1980

VANCOUVER LAKE

Vancouver Lake, with a surface area of 2,600 acres, is situated at Vancouver, Clark County, Washington, in the Portland-Vancouver Metropolitan area. Clark County's population is 185,000, but the lake draws visitors from a much wider area in Washington and Oregon, with a population of 1.3 million.

The uses of the land around Vancouver Lake include agriculture (truck crops, grains, hay, dairy and beef), game production, urban development and vacant land zoned industrial and residential. The State of Washington, Clark County, and the Port of Vancouver are major landowners. At present, much of the land is prone to flooding, but a 350,000-acre Corps of Engineers diking project is planned for the area which will increase the amounts of land available for agriculture and development.

Current uses of Vancouver Lake and its adjacent lands include duck and pheasant hunting, fishing (primarily carp and crappies), picnicking, hiking, bird watching, and limited sailing. Swimming and high-quality fishing are not possible because of water quality, extensive boating is precluded by shallowness, and camping and other lakeside activities are not available becuase of lack of facilities.

Vancouver Lake is highly eutrophic and silted in with nutrient-enriched sediment. The project's objectives are to meet water quality standards, improve recreational capacity, and, in conjunction with an active 208 program, to reduce non-point source pollutant loadings from the watershed. It involves extensive dredging, construction of a flushing channel to bring Columbia River water through the lake, and implementation of best management practices.

Only pilot dredging has been completed, so all benefits to be discussed below are projected by the grantee on the basis of present use and regional demand. They include improvements in quality and increases in variety and volume of recreation, aesthetic improvement, benefits to the regional economy, agricultural improvements, public health, and education and research and development.

Recreation

The county park at Vancouver Lake is presently under-utilized. When the lake restoration project is complete, it will be the keystone of a total land-and-water recreational complex already developed to serve the region. In 1978, approximately 120,000[3] people used the county park at the lake, and, in 1974, 120,000[5] use-days were estimated for the state game lands bordering the lake. Using a UDV of \$1.66 (10/6/5/6/2 = 29) for pre-restoration general recreation and \$9.00[5] for hunting, the existing annual recreational benefit is \$1,279,200. The grantee projects the following post-project benefits and UDVs, which seem reasonable in light of present use, intended improvement, and regional demand:

Activity	Use-Days[5]	UDV[5]	Benefits[5]
Camping	24,000	\$2.00	\$ 48,000
Picnicking	36,000	2.00	72,000
Swimming	940,000	2.00	1,880,000
Sightseeing	250,000	2.00	500,000
Fishing	70,000	2.25	157,500
Boating	100,000	5.00	500,000
Hiking	250,000	2.00	500,000
Biking	500,000	2.00	1,000,000
Total	2,080,000		\$4,657,500

Since the quality of the lake is already so poor, one can assume that the existing levels of recreation would not decrease without the project. Consequently, existing benefits must be deducted from projected totals to determine the increment assignable to the Clean Lakes project. Because the projected total was calculated in 1976, it must first be adjusted for inflation, using the Consumer Price Index (1976 = 170.5, mid-1979 = 216.6); it becomes \$5,916,800 in 1979 dollars. Projected recreation benefits are therefore \$5,916,800 - \$1,279,200 = \$4,637,600. Hunting has been excluded from the incremental benefit, since the projected total in use-days for that activity was the same as the 1974 recorded volume.

Aesthetics

The lake presently emits unpleasant odors which will be eliminated by the project. The benefits of this and other aesthetic improvements are included in the calculations for recreation.

Regional Economy

This project, coupled with work being accomplished under 208 and work contemplated by the Corps of Engineers, will encourage agricultural, commercial, industrial, residential, and recreational development, all of which are of vital interest to Vancouver and Clark County. In addition, dredge spoil can be used to reclaim land for development (see Agriculture). The actual monetary benefit has not been projected.

Agriculture

Spoil to be removed from the lake will be suitable for farming. It can be used to elevate low-lying lands, to construct dikes, and to condition soil. Soil improvement will permit two crops per season instead of one, and coupled with flood control, conversion from pasture to cultivated crops. Approximately 10 million cubic yards will be available.[5] A conservative estimate of the benefit is the one-time cost of obtaining fill, which can be assumed to be $1.50 per cubic yard. Actual benefit could be much greater and longer-lived, depending on the uses of the filled land.

10,000,000 x $1.50 = $15,000,000

Public Health

Typical fecal coliform counts in the lake range from 1,300 to 9,500[5] colonies per 100 ml., making the water unsafe for contact recreation. The best measure of benefit from elimination of this problem is $1,880,000, already included as the value of project swimming use under Recreation.

Education, Research and Development

A film has been made on the lake to heighten public awareness of its problems and the project. New dredging techniques and equipment will be tested during the project. Other lake groups have contacted the Port of Vancouver to determine applicability to their situations. Area colleges have used the lake as an outdoor laboratory.

SUMMARY OF BENEFITS

VANCOUVER LAKE

Recreation	$ 4,637,000
Aesthetics	included in recreation
Regional Economy	+
Agriculture	$15,000,000*
Public Health	included in recreation
Education, Research and Development	+
Total First Year	$19,637,600+
Total Discounted Benefit	$47,370,000
314 Grant Amount	$ 3,468,328

*Included in first year only.

Data Sources:

1. Port of Vancouver
2. Clark County Board of Realtors
3. Clark County Parks Department
4. Clark County Regional Planning Commission
5. "Vancouver Lake Reclamation", Port of Vancouver, April, 1976
6. "Vancouver Lake Rehabilitation", Dames and Moore, 1977
7. "Pilot Dredge Program, Vancouver Lake", Dames and Moore, April, 1977

Date of Site Visit: January 11, 1980

WASHINGTON PARK LAKE

Washington Park Lake is a lake of approximately 5.8 acres located in 90-acre Washington Park, Albany, New York. The park, one of ten major parks in Albany, attracts primarily passive recreational activities, such as picnicking and strolling, and is the site of two major city fairs held annually, as well as numerous arts and crafts fairs throughout the summer.[4] Before its deterioration, the lake was the major park amenity. The lake and park are accessible to Albany's population of 109,900, with an additional population of 176,800 residing in the county. There is little tourist use of the lake area.

Before the restoration rpoject was initiated, the major problem was a "build-up of decaying organic matter", reducing lake depth and volume.[3] The lake contained relatively little algae, but its fish population had been reduced by the growth of rooted aquatic plants.

The lake was drained and the bottom sediment removed by dredging. The project was completed in August 1977. While levels of nitrogen and phosphorus are still high enough to support algae growth and possible aquatic weed growth, the lake is relatively clean, although classified as meso-eutrophic.[2]

The lake is the discharge point for stormwater in the park, including runoff from the disposal area for fall leaf collections, with fifteen discharge points located along the shoreline. It is likely that watershed management and/or diversion of stormwater will eventually be necessary to maintain long-term benefits.

The project yielded recreational, educational, and aesthetic benefits.

Recreation Benefits

Recreation uses of the lake, which did not change after improvement, consist of strolling, picnicking (including extensive lunchtime use by individuals working in the area), and fishing.[1] The project improved the quality of the activities, but, except for fishing and 4-H camper use, did not affect the number of users.

In 1978 and 1979, a pilot project sponsored under the Urban Fisheries Program for the lake resulted in 5,099 angler trips in 1978 and 2,833 trips in 1979.[7] If the city supports a stocking program, it is estimated that there will be 10,800 annual angler trips in 1980-87. While there was limited fishing on the lake before the improvement, no use estimates are available. Consequently, it will be conservatively assumed that the improvement will directly result in an annual increase of 3,966 angler trips (the average of 1978 and 1979 levels) in 1980-87. Since these are new visits generated to the lake, the value can be estimated as the full unit day value times 3,966. Applying the post-improvement general fishing UDV of $2.26 (10/5/8/11/5 = 39) yields an annual benefit increase (1980-87) of $8,963.

It is expected that the improvement will increase lake visits by children from two 4-H day camps located nearby.[6] Conservatively, assuming that camper visits are increased by one visit annually, this yields an annual benefit increase of (250 x 2.26) = $565.

Education Benefits

The improvement resulted in educational benefits during the summers of 1977-1979, when Youth conservation Corps enrollees worked at the lake site.[1] With work at Buckingham Lake, the Washington Park Lake project represented approximately 50 percent of the Youth Conservation Corps program during the three years.

Aesthetic Benefits

Aesthetic benefits due to pollutant reduction are large unquantifiable. Lake quality impacts the attendance at some special park events, such as recently instituted trial concerts.[5] There are still community pressures for lake improvement and, reportedly, odor is a problem. There are no estimates of the number of visits impacted by aesthetic considerations, before and after the improvement. It has been estimated that the increase in Washington Park Lake UDV due to improved aesthetics (environmental quality) was $.09 (a 5-point improvement in environmental quality). If it is further assumed that, due to the improvement, there was one more annual visit to the lake area by Albany residents greater than 13 years old, the value of increase aesthetic benefits is:

$$109{,}900 \times .78 \times .09 = \$7{,}715,$$

where the U.S. ratio of population older than 13 to total population, 78 percent, has been applied. This age distribution has been assumed to avoid double counting, as a large proportion of the anglers and all of the 4-H campers are children.

SUMMARY OF BENEFITS

WASHINGTON PARK LAKE	
Recreation	
Fishing	$ 9,000
Day camp	600
Education	+
Aesthetics	7,700
Total First Year	$ 17,300
Total Discounted Benefits	$120,800
314 Grant Amount	$ 23,250

Data Sources:

1. City of Albany Departments: Assessment
   Recreation
   Planning
   Human Resources
2. Project Report Restoration of Washington Park Lake, Albany County, New York and Post-Restoration Monitoring of Chemical, Physical, and Biological Lake Characteristics (1978).
3. Environmental Protection Agency Region II, Clean Lakes Coordinator
4. City of Albany Chamber of Commerce Statistics, Albany City Budget, FY 1979-80.
5. Washington Park Association representative
6. 4-H Club representative
7. New York Urban Fisheries Program information

Date of Site Visit: January 7, 1980

Appendix C

UNIT DAY VALUE METHOD
FOR
ESTIMATING RECREATION AND AESTHETIC BENEFITS

Appendix 3 to Subpart K

18 CFR 713

Appendix 3 to Subpart K—Unit Day Value Method

Note.—This appendix is provided for background information only. Adherence to material presented in this appendix is not required, and shall not be considered binding.

The unit day value (UDV) method for estimating recreation benefits relies on expert or informed opinion and judgment to approximate the average willingness to pay of users of Federal or Federally assisted recreation resources. If an agency can demonstrate that more reliable TCM or CVM estimates are either not feasible or not justified for the particular project under study, as discussed under applicability criteria, the UDV method may be used; by applying a carefully thought-out and adjusted unit day value to estimated use, an approximation is obtained that may be used as an estimate of project recreation benefits.

(a) *Implementation.* (1) When the UDV method is used for economic evaluations, planners will select a specific value from the range of values provided in the most current published schedule. Application of the selected value to estimated annual use over the project life, in the context of the with- and without-project framework of analysis, provides the estimate of recreation benefits.

(2) Two categories of outdoor recreation days, general and specialized, may be differentiated for evaluation purposes. "General" refers to a recreation day involving primarily those activities that are attractive to the majority of outdoor users and that generally require the development and maintenance of convenient access and adequate facilities. "Specialized" refers to a recreation day involving those activities for which opportunities in general are limited, intensity of use is low, and a high degree of skill, knowledge, and appreciation of the activity by the user may often be involved.

(3) Estimates of total recreation days of use for both categories, where applicable, will be developed. The general category comprises the great majority of all recreation activities associated with water projects, including swimming, picnicking, boating, and most warm water fishing. Activities less often associated with water projects, such as big game hunting and salmon fishing, are included in the specialized category. A separate range of values is provided in a conversion table (Table 1) for each category and for fishing and hunting to facilitate adoption of a point system in determining the applicable unit values for each individual project under consideration.

Table K-3 1 - Conversion of Points to Dollar Values

ACTIVITY	POINT VALUES										
CATEGORIES	0	10	20	30	40	50	60	70	80	90	100
General Recreation (Points from Table K-3 2)	1.07	1.25	1.44	1.68	1.93	2.30	2.48	2.67	2.85	3.04	3.22
General Fishing and Hunting (Points from Table K-3 2)	1.57	1.74	1.90	2.07	2.28	2.51	2.73	2.94	3.06	3.17	3.20
Specialized Fishing and Hunting (Points from Table K-3 3)	7.50	7.69	7.88	8.08	8.27	9.03	9.80	10.57	11.34	12.10	12.87
Specialized Recreation Other than Fishing and Hunting (Points from Table K-3 3)	4.29	4.65	5.00	5.36	5.72	6.44	7.15	8.58	10.01	11.44	12.87

NOTE: Unit day recreation values may not exceed the values provided by this table.

(4) When employing this method to determine recreation benefits, departure from the range of values provided is not permitted. If evidence indicates a value outside the published range, the TCM or CVM method is required.

(5) In every case, planners are expected to explain the selection of any particular value. To assist in explaining a specific value, a point rating method may be used. The method illustrated here contains five specific criteria and associated measurement standards designed to reflect quality, relative scarcity, ease of access, and esthetic features. Since the list of criteria and weights assigned may vary with the situation, public involvement should occur in the value determination process. Planners in the various agencies are also expected to make appropriate use of studies of preferences, user satisfaction, and willingness to pay for different characteristics. In using these studies, particular efforts should be made to use estimates derived elsewhere from applications of the TCM and CVM techniques, to support the value selected.

(i) *General recreation (Table 2).* Activities in this category are those associated with relatively intensive development of access and facilities as compared to the specialized recreation category. Generally, progressively higher physical standards for each unit of carrying capacity is involved in selecting higher unit values, and these may be accompanied by larger related nonproject costs.

(ii) *Specialized recreation (Table 3).* (A) This category includes those activities whose values are generally lowered, if not actually excluded, by the type of development that enhances activities in the general recreation category. Thus, extensive or low density use and development constitutes the higher end of this range of values (e.g., big game hunting and wilderness pack trips). Also included in the upper end of the range are relatively unique experiences such as inland and marine fishing for salmon and steelhead, white water boating and canoeing, and long-range boat cruises in areas of outstanding scenic value. Examples of activities to which values at the lower end of the range would be assigned include upland bird hunting and specialized nature photography.

Table K-3 3 - Guidelines for Assigning Points for Specialized Recreation

Criteria	Judgment Factors				
a) Recreation Experience 8/	Heavy use or frequent crowding or other interference with use	Moderate use, other users evident and likely to interfere with use	Moderate use, some evidence of other users and occasional interference with use due to crowding	Usually little evidence of other users, rarely if ever crowded	Very low evidence of other users, never crowded
Total Points: 30					
Point Value:	0-4	5-10	11-16	17-23	24-30
b) Availability of Opportunity 7/	Several within 1 hr. travel time; a few within 30 min. travel time	Several within 1 hr. travel time; none within 30 min. travel time	One or two within 1 hr. travel time; none within 45 min. travel time	None within 1 hr. travel time	None within 2 hr. travel time
Total Points: 18					
Point Value:	0-3	4-6	7-10	11-14	15-18
c) Carrying Capacity 1/	Minimum facility development for public health and safety	Basic facilities to conduct activity(ies)	Adequate facilities to conduct without deterioration of the resource or activity experience	Optimum facilities to conduct activity at site potential	Ultimate facilities to achieve intent of selected alternative
Total Points: 14					
Point Value:	0-2	3-5	6-8	9-11	12-14
d) Accessibility	Limited access by any means to site or within site	Fair access, poor quality roads to site; limited access within site	Fair access, fair road to site, fair access, good roads within site	Good access, good roads to site; fair access, good roads within site	Good access, high standard road to site; good access within site
Total Points: 18					
Point Value:	0-3	4-6	7-10	11-14	15-18
e) Environmental Quality	Low esthetic factors 5/ exist that significantly lower quality 6/	Average esthetic quality; factors exist that lower quality to minor degree	Above average esthetic quality; any limiting factors can be reasonably rectified	High esthetic quality; no factors exist that lower quality	Outstanding esthetic quality; no factors exist that lower quality
Total Points: 20					
Point Value:	0-2	3-6	7-10	11-15	16-20

1/ Value should be adjusted for overuse.

2/ Value for water-oriented activities should be adjusted if significant seasonal water level changes occur.

3/ General activities include those that are common to the region and that are usually of normal quality. This includes picnicking, camping, hiking, riding, cycling, and fishing and hunting of normal quality.

4/ High quality value activities include those that are not common to the region and/or Nation and that are usually of high quality.

5/ Major esthetic qualities to be considered include geology and topography, water, and vegetation.

6/ Factors to be considered in lowering quality include air and water pollution, pests, poor climate, and unsightly adjacent areas.

7/ Likelihood of success at fishing and hunting.

8/ Intensity of use for activity.

Table K-3 2 - Guidelines for Assigning Points for General Recreation

Criteria	Judgment Factors				
a) Recreation Experience	Two general activities 3/	Several general activities	Several general activities; one high quality value activity 4/	Several general activities; more than one high quality high activity	Numerous high quality value activities; some general activities
Total Points: 30					
Point Value:	0-4	5-10	11-16	17-23	24-30
b) Availability of Opportunity 7/	Several within 1 hr. travel time; a few within 30 min. travel time	Several within 1 hr. travel time; none within 30 min. travel time	One or two within 1 hr. travel time; none within 45 min. travel time	None within 1 hr. travel time	None within 2 hr. travel time
Total Points: 18					
Point Value:	0-3	4-6	7-10	11-14	15-18
c) Carrying Capacity 1/	Minimum facility development for public health and safety	Basic facilities to conduct activity(ies)	Adequate facilities to conduct without deterioration of the resource or activity experience	Optimum facilities to conduct activity at site potential	Ultimate facilities to achieve intent of selected alternative
Total Points: 14					
Point Value:	0-2	3-5	6-8	9-11	12-14
d) Accessibility	Limited access by any means to site or within site	Fair access poor quality roads to site; limited access within site	Fair access, fair road to site; fair access, good roads within site	Good access, good roads to site; fair access, good roads within site	Good access, high standard road to site; good access within site
Total Points: 18					
Point Value:	0-3	4-6	7-10	11-14	15-18
e) Environmental Quality	Low esthetic factors 5/ exist that significantly lower quality 6/	Average esthetic quality; factors exist that lower quality to minor degree	Above average esthetic quality; any limiting factors can be reasonably rectified	High esthetic quality; no factors exist that lower quality	Outstanding esthetic quality; no factors exist that lower quality
Total Points: 20					
Point Value:	0-2	3-6	7-10	11-15	16-20

1/ Value should be adjusted for overuse.

2/ Value for water-oriented activities should be adjusted if significant seasonal water level changes occur.

3/ General activities include those that are common to the region and that are usually of normal quality. This includes picnicking, camping, hiking, riding, cycling, and fishing and hunting of normal quality.

4/ High quality value activities include those that are not common to the region and/or Nation and that are usually of high quality.

5/ Major esthetic qualities to be considered include geology and topography, water, and vegetation.

6/ Factors to be considered in lowering quality include air and water pollution, pests, poor climate, and unsightly adjacent areas.

7/ Likelihood of success at fishing and hunting.

8/ Intensity of use for activity.

(B) The unit day values to be used for both the general and specialized recreation categories should be further adjusted to reflect additional quality considerations expected to prevail at various project sites in various regions of the Nation, and weighted according to their importance to users. For example, a reservoir that is expected to carry a relatively heavy load of suspended silt or is expected to be used beyond optimum capacity would be less desirable, and therefore of lower unit value, than one that will have clear water and be less crowded.

(C) Hunting and fishing may be treated either as general recreation (Table 2) or specialized recreation (Table 3) depending upon whether it is associated with developed areas or back country areas, respectively. In either case, the recreation experience (criterion "a" in the tables) will be given points according to the additional consideration of the chances of success; the midpoint of the value range is associated with the region's average catch or bag. Other criteria may be modified if appropriately based on available evidence about the preferences and willingness to pay of hunters and fishermen for different recreation quality factors.

(D) The degree to which alternative nonproject opportunities are available to users is also considered in the assignment of values. Higher values should be assigned if the population to be served does not have existing water-oriented recreation opportunities. If water-oriented recreation opportunities are relatively abundant, as compared to other outdoor recreation opportunities, lower unit values should be assigned, even if a large number of visitations are expected at the proposed development.

(E) The choice of a unit day value must account for transfers to avoid double counting of benefits. The net value of a transfer of use from one site to another is the difference in unit day values for recreation at the two sites. If recreation activities at the two sites are comparable, travel cost savings are the only NED benefits associated with the transfer. Use at the site must therefore be disaggregated according to the proportion of total estimated use that is activity that would not have occurred without the project and the proportion of total use that represents transfers from existing sites. The respective types of uses must then be assigned different daily values as indicated.

(iii) *Establishing specific values within each range.* Unit values selected are to be considered net of all associated costs of both the users and others in using or providing these resources and related services. Agencies will be encouraged, through review procedures, demonstration projects, and educational workshops, to adopt the TCM and CVM techniques for project evaluations that would otherwise have used UDVs. As agencies gradually adopt CVM and TCM and develop a more comprehensive set of regional models, reliance on the UDV can be expected to diminish.

(b) *Estimating use in the UDV method.* (1) Using the ranges of values requires first the study of estimates of annual use foregone and expected at recreation sites. Use can be estimated by a use estimating equation or per capita use curve as discussed above, but these means are available, the second step of the travel cost methods should generally be used instead of UDVs to derive the benefit.

(2) The capacity method is an alternative method of estimating use, but it has severe limitations. The capacity procedure involves the estimation of annual recreation use under without-project and with-project conditions through the determination of resource or facility capacities (taking into consideration instantaneous rates of use, turnover rates, and weekly and seasonal patterns of use). Seasonal use patterns are dependent on climate and culture and probably account for the greatest variation in use estimates derived through this method. In general, annual use of outdoor recreation areas, particularly in rural locations and in areas with pronounced seasonal variation, is usually about 50 times the design load, which is the number of visitors to a recreation area or site on an average summer Sunday. In very inaccessible areas and in those known for more restricted seasonal use, the multiplier would be less; in urban settings or in areas with less pronounced seasonal use patterns, the multiplier would be greater. In any case, the actual estimation of use involves an analytical procedure using instantaneous capacities, daily turnover rates, and weekly and seasonal use patterns as specific data inputs.

(3) Because the capacity method does not involve the estimation of site-specific demand, its use is valid only when it has been otherwise determined that sufficient demand exists in the market area of project alternatives to accommodate the calculated capacity. Its greatest potential is therefore in urban settings where sufficient demand obviously exists. Additionally, its use should be limited to small projects with (i) a facility orientation (as opposed to a resource attraction), and (ii) restricted market areas that would tend to make the use of alternative use estimating procedures less useful or efficient.

(c) *Calculating values.* The estimates of annual use are combined with the selected unit day values to get an estimate of annual recreation benefits. The value assigned to each activity or category of activities is multiplied by the number of recreation days estimated for that activity. The products are then summed to obtain the estimate of the total value of an alternative. Recreation days to be gained and lost or foregone as a result of a particular alternative are listed and valuated separately, not merely shown as net recreation days. Transfers of recreational users to or from existing sites in the region must be calculated, and the net regional gain or loss used in the final benefit estimated. Adequate information must appear in the discussion of the use estimation and valuation procedure or elsewhere in the report concerning the alternative being considered, so that the reader can derive a similar value for each activity.

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